Improving the readability and suitability of a webpage on age-related hearing loss for better comprehension and self-efficacy

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ABSTRACT

Aim: The study aimed to firstly revise a webpage on age-related hearing loss to achieve better readability and suitability. Secondly, the study aimed to assess whether significant differences in comprehension and self-efficacy resulted from the revision. Thirdly, the study aimed to investigate if there were any significant correlations between (a) comprehension and self-efficacy, (b) self-efficacy and age, and (c) comprehension and age.

Method: A webpage on age-related hearing loss was chosen for revision as it typified most consumer webpages on hearing health. The webpage was revised using best practice guidelines. Readability formulae (F-K, FRE, FOG and SMOG) were used to evaluate the reading grade levels of the unrevised and revised webpages. The Suitability Assessment of Materials (SAM) tool was used to evaluate the suitability of the unrevised and revised webpages. Both versions of the webpages and study questionnaire were uploaded onto Qualtrics survey software. Participants were randomly allocated to read either the unrevised or revised version and requested to answer multiple-choice questions assessing their reading comprehension and self-efficacy. Statistical analysis was performed using SPSS.

Results: The mean reading grade level of the unrevised webpage was 12.2 and this was improved to 5.6 after revision. The suitability of the unrevised webpage was improved from ‘not suitable’ to ‘superior’ following revision. The Mann-Whitney *U* Test showed that comprehension scores were significantly higher for the revised group than for the unrevised group ($U = 91.5$, $p = .007$). Similarly, self-efficacy scores were significantly higher for the revised group than for the unrevised group ($U = 65.5$, $p < 001$). Spearman’s correlation did not show a significant correlation between comprehension and self-efficacy ($r_s = .095$, $p = .570$). Likewise, there was no significant correlation between self-efficacy and age ($r_s = −.105$, $p = .531$). There was also no significant correlation between comprehension and age ($r_s = -.309$, $p = .059$).

Conclusion: There is a need for information on the internet pertaining to hearing health to be revised for greater readability and suitability. The findings from this study are consistent with previous studies which show that comprehension and self-efficacy improve significantly when reading grade levels are within recommended levels, and suitability is 'superior'. Self-efficacy in older adults can be increased through health information which is easy to read, education programmes on healthy ageing, and support from family, friends, and health professionals. Increased self-efficacy for managing hearing loss leads to a greater likelihood that individuals will take appropriate action and thus achieve good health outcomes.

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ARHL	Age-related hearing loss
dB HL	Decibel Hearing Level
F-K	Flesch-Kincaid
FRE	Flesch Reading Ease Score
FOG	Gunning Fog Index
ICC	Intraclass correlation coefficient
kHz	Kilohertz
RGL	Reading Grade Level
SAM	Suitability Assessment of Materials
SMOG	Simple Measure of Gobbledygook
US	United States
WHO	World Health Organisation

CHAPTER 1: INTRODUCTION

1.1 Hearing Loss

Around 5% of the world's population live with disabling hearing loss and this is expected to rise to 10% by 2050 (World Health Organization [WHO], 2020). Disabling hearing loss for adults is defined as a hearing loss of greater than 40 decibels (dB HL) averaged in the better hearing ear (WHO, 2020). Due to the ageing global population and the association of hearing loss with ageing, the prevalence of hearing loss is expected to increase (Goman et al., 2017).

1.1.2 Age-Related Hearing Loss

Age-related hearing loss (ARHL), also called presbycusis, is a term used for hearing loss in the elderly (Gates & Mills, 2005). ARHL is one of the most common chronic conditions in older adults (Nash et al., 2011) and is more common in males and whites (Agrawal et al., 2008; Helzner et al., 2005; Lin et al., 2011). It is not possible to isolate the effects of ageing from various other factors contributing to ARHL (Gates & Mills, 2005). Many studies show that previous noise exposure increases the prevalence of hearing loss in older adults (Agrawal et al., 2008; Cruickshanks et al., 1998; Gates & Mills, 2005; Helzner et al., 2005; Schuknecht & Gacek, 1993). Other factors associated with increased prevalence of hearing loss in older adults include smoking, diabetes, hypertension (Agrawal et al., 2008), cerebrovascular disease (Helzner et al., 2005), and genetic predisposition (Gates & Mills, 2005).

In ARHL, high frequencies are the first to be affected, followed by the mid and lower frequencies (Gates & Mills, 2005; Jafari et al., 2019) The loss of hearing in the high frequencies results in difficulties with understanding speech in noise, however as the loss progresses to involve lower frequencies, speech understanding in quiet is also affected (Gates

& Mills, 2005). Additionally, individuals with hearing loss may also experience tinnitus, which is the perception of sound in the absence of external sound sources (Chari & Limb, 2018; Jafari et al., 2019; Omidvar & Jafari, 2019).

1.1.3 The Impact of Unmanaged Hearing Loss

Unmanaged hearing loss can reduce the quality of life by causing social, emotional, cognitive, and communication difficulties (Bowl & Dawson, 2019; Ciorba et al., 2012; Dixon et al., 2020; Monzani et al., 2008; Mulrow et al., 1990; Weinstein & Ventry, 1982). Consequently, relationships with family, friends, and work colleagues might become strained. Additionally, the hearing impaired person might experience fatigue due to the increased listening effort required during conversations (Arlinger, 2003; Bainbridge & Wallhagen, 2014). Due to difficulties in communicating, communication partners may decide to avoid or reduce verbal contact with individuals with hearing impairment (Arlinger, 2003). Furthermore, individuals with hearing impairment might withdraw from social activities and outings, due to reduced speech understanding, thus reducing their intellectual and cultural stimulation (Arlinger, 2003). As a result, unmanaged hearing loss leads to poorer quality of life due to the effects of isolation and reduced social activity which increases the likelihood of depression (Arlinger, 2003). These negative effects also extend to the spouses of hearing impaired individuals as spouses are influenced by the psychological well-being of each other (Dufouil et al., 2000).

Unmanaged hearing loss affects earning capacity because hearing impaired individuals are more likely to be unemployed or only partially employed, compared to their normal-hearing peers (Jung & Bhattacharyya, 2012) and thus tend to earn less even when education levels have been accounted for (Emmett & Francis, 2015). Lower earnings can occur because of lost opportunities, missed promotions, and poor work performance due to communication breakdowns from unmanaged hearing loss (Kochkin, 2005). Furthermore,

hearing impairment is linked with early retirement and increased use of sickness or disability benefits (Helvik et al., 2013; Pierre et al., 2012).

Globally, unmanaged hearing loss results in a cost of USD 750 billion annually (WHO, 2020). In the US, the estimated economic costs of lost productivity due to hearing impairment ranges from USD 1.8 to 194 billion annually (Huddle et al., 2017). In addition, medical expenses arising from increased falls, hospitalisations, associated depression, and caregiver expenses due to hearing impairment amount to billions of dollars each year (Huddle et al., 2017).

1.1.4 Benefits of managing ARHL

The use of amplification can significantly improve individuals' quality of life through reducing the negative social and emotional effects of hearing loss (Bainbridge & Wallhagen, 2014; Ferguson et al., 2017). Consequently, hearing impaired individuals are more likely to feel less isolated and when hearing loss is managed. The use of amplification can improve the quality of life and produce long term benefits, regardless of the degree of hearing loss (Arlinger et al., 2017; Lotfi et al., 2009; Mulrow et al., 1990). Managing hearing loss can result in financial benefits, because individuals are more likely to remain in the workforce when communication difficulties are reduced (Hogan et al., 2009). Additionally, increased safety in the workplace can result from managing hearing loss. Studies have shown that the use of amplification substantially mitigated the loss of income due to hearing loss (Harris et al., 1995; Kochkin, 2010). Managing hearing loss is therefore extremely beneficial to individuals. Effective management of hearing loss requires long term behaviour changes which are adhered to most successfully when individuals participate in the decision making process (Pryce & Hall, 2014).

1.2 Shared Decision Making

1.2.1 Definition of Shared Decision Making

Shared decision making is the sharing of best available evidence between clinicians and patients in order to help patients make informed choices (Charles et al., 1997; Elwyn et al., 2010). For shared decision making to occur, patients should firstly have access to evidence based information and receive guidance on weighing up the respective benefits and drawbacks of their options (Elwyn et al., 2010). Furthermore, patient participation should be encouraged through a culture which is supportive of their input (Elwyn et al., 2010). Shared decision making engages patients as it requires them to reflect on the benefits and drawbacks of screening and management options, and consequently express their preference (Elwyn et al., 2010). This contrasts with the traditional paternalistic or clinician centred approach, where patients play a passive role in their treatment choices and their freedom to make decisions is restricted by the health professional (Charles et al., 1997; Dworkin, 1988).

1.2.2 Shared Decision Making and Consumers' Rights

Consumers have the right to make informed decisions (Health and Disability Commissioner, 1996; United Nations, 1985). To date, the right to make informed decisions has been implemented in over a hundred countries globally (Consumers International, 2016), thus highlighting its importance. Making informed decisions is an integral component of shared decision making, which has been described as an 'ethical imperative' (Pryce & Hall, 2014).

1.2.3 Benefits of Shared Decision Making

Shared decision making enables the four principles of biomedical ethics to be upheld (Stiggelbout et al., 2012). These are autonomy, beneficence, non-maleficence, and justice (Beauchamp & Childress, 2001). Patients' autonomy is respected through the process of shared decision making as this enables them to make informed choices (Stiggelbout et al.,

2012). As most patients prefer more conservative treatment options, the upholding of patients' autonomy offers an additional advantage of reducing health care costs (Pryce & Hall, 2014). Beneficence enables patients to be protected, as it involves the weighing up of the benefits, risks, and costs of treatment in order to achieve non-maleficence - the avoidance of harm (Stiggelbout et al., 2012). Harm may result if patients proceed with procedures which they would have avoided had they been better informed (Stiggelbout et al., 2012). The fourth principle, justice is achieved in two ways: firstly, by fairly distributing benefits, risks, and costs, and secondly by enabling individuals who are less educated to participate in shared decision making to the same extent as individuals with higher levels of education (Stiggelbout et al., 2012).

Shared decision making is a component of patient-centred care (Pryce & Hall, 2014). Together, shared decision making and patient-centred care are essential components of healthcare (Michie et al., 2003). According to the Committee on Quality of Health Care in America (2001) patient centred care involves basing clinical decisions on individual patient's preferences, needs and values. This has the advantage of reducing pressure on clinicians (Pryce & Hall, 2014). Additionally, patients will have better adherence to management and treatment, as well as improved patient outcomes and increased satisfaction, compared to a paternalistic approach (Laplante-Lévesque et al., 2014; Michie et al., 2003). Thus, shared decision making and patient centred care benefits both health consumers as well as health professionals. In order to make informed decisions, consumers would require access to health information which they can understand.

1.2.4 Sources of Health Information

There is a wealth of sources from which health information can be obtained, including newspapers, magazines, books, brochures, the internet and also nonprint media such as radio and television (Kutner et al., 2006). Health information could also be provided by friends and

family, or through conversations with health professionals (Kutner et al., 2006). A systematic review concluded that those with low health literacy levels are unlikely to use the internet as a source for health-related information (Kim & Xie, 2017). Kim and Xie (2017) proposed that the lack of self-efficacy in navigating the internet creates a barrier to locating health information on the internet. In America, around 10% of American adults do not use the internet (Pew Research Center, 2019). Individuals who are less likely to use the internet are those over the age of 65 years, African-Americans, Hispanics, those with less education, low income, and rural location (Pew Research Center, 2019). Instead of obtaining health information from the internet, those with 'below basic' health literacy levels tended to utilise non written sources such as radio and television (Kutner et al., 2006).

Amongst internet-users, the use of the internet as a source of health-related information has risen since 2003 (Prestin et al., 2015). Around 70% of Americans turned to the internet as their first source of health information (Prestin et al., 2015) and 70% of consumers have made health care decisions influenced by reading online information (Rainie & Fox, 2000). Whilst reading health information online has benefits such as supplementing patient knowledge and increasing the potential for discussion and interaction between physician and patients (Eysenbach, 2003; Ihler & Canis, 2019; Tan & Goonawardene, 2017), it also has some drawbacks. These drawbacks include readers becoming confused or overwhelmed by the myriad of information encountered (Eysenbach, 2003). Subsequently misinterpretations of the material might be likely to occur. Furthermore, consumers do not readily reveal their internet searches to their physicians (Ihler & Canis, 2019; Tan & Goonawardene, 2017) and therefore, any errors in their understanding might not be noticed and rectified by clinicians.

1.2.5 The Role of Health Information in Promoting Patient Centred Care

As mentioned earlier, patient centred care involves the discussing of viewpoints with the clinician and participating in informed decision making. Whilst health information on the internet can help health consumers engage in discussions with their clinicians, (Tan & Goonawardene, 2017) the information must be accurate and suitably matched to their literacy levels in order to be effective (Cheng & Dunn, 2015; Walsh & Volsko, 2008). Patients can only make informed choices when they fully understand the benefits and drawbacks of possible treatment options, including the option of not pursuing any treatment (Stiggelbout et al., 2012).

Information which has been suitably written is therefore indispensable and is the key to participation in shared decision making (Noordman et al., 2019). Through accessing information which is easy to read, even individuals with low literacy can be equipped with sufficient knowledge (Noordman et al., 2019). Subsequently, this will enable them to ask questions and engage in discussion with their health professional (Noordman et al., 2019). Matching the literacy demands of health information to the literacy level of the target audience is therefore a crucial aspect in achieving patient centred care.

1.3 Health Literacy

1.3.1 The Definition of Health Literacy

The term ‘health literacy’ can be defined as the capacity of an individual to “obtain, process and understand basic health information” in order to make suitable healthcare decisions which encourage good health (Ratzan & Parker, 2000, p.vi; WHO, 1998). Individuals with high health literacy are therefore empowered because they can access and apply health information appropriately to benefit their health (WHO, 1998). However, those with low health literacy are likely to struggle in their understanding and application of health-

related information (Kindig et al., 2004; Parker, 2000) and thus their ability to participate in shared decision making will be restricted (Zamora & Clingerman, 2011).

1.3.2 Influential Factors on Health Literacy

In the US, health literacy is linked to age, socioeconomic status, race, cognition, and education level (Chesser et al., 2016). This is consistent with findings in Europe, which showed that financial deprivation, social status, education, and older age were predictors of low health literacy (Sørensen et al., 2015). In New Zealand, health literacy is on average, poor, with Māori having lower health literacy skills than non- Māori (Ministry of Health, 2010). The average health literacy score in New Zealand was 275, which is the minimum score needed to cope with the demands of daily living (Ministry of Health, 2010). Consistent with studies from other countries, lower health literacy in New Zealand was associated with low education levels, low income, rural location, and unemployment (Ministry of Health, 2010).

Lower levels of health literacy have been associated with increasing age. Individuals beyond the age bracket of 65 to 69 years had lower health literacy than younger age groups, and those over 85 years of age had the lowest health literacy (Baker et al., 2000; Cutilli, 2007; Gazmararian et al., 1999). Indeed, only 3% of adults over the age of 65 years had 'proficient' health literacy levels (Kutner et al., 2006). Other contributing factors to declining levels of health literacy in older adults include decreasing levels of cognition, (McDougall Jr et al., 2012; Wolf et al., 2010) as well as hearing and vision loss (Speros, 2009).

Health literacy is related to the level of education (Kutner et al., 2006; McDougall Jr et al., 2012; Wolf et al., 2010). To illustrate, 49 % of individuals who had not completed or never attended high school had 'below basic' health literacy, compared with only 3% of individuals with a Bachelor's degree (Kutner et al., 2006). The 2003 US National

Assessment of Adult Literacy revealed that 36% of adults had at best, a basic level of health literacy, 53% had ‘intermediate’ health literacy and only 12% had ‘proficient’ health literacy levels (Kutner et al., 2006).

Adults with ‘basic’ health literacy could understand simple, familiar texts and solve easy, one-step arithmetic problems using quantitative information provided. However, they would struggle with the tasks in the ‘intermediate’ category, which required interpreting information presented in tables, graphs, and more complex texts, as well as with making inferences, summarising, understanding cause and effect, and recognising the author’s purpose (Kutner et al., 2006). For individuals to attain the highest level of health literacy known as ‘proficient’ health literacy, the ability to synthesise and make complex inferences would be required (Kutner et al., 2006). Individuals with low health literacy were more likely to be non-white (Baker et al., 2007; Wolf et al.), with African Americans and Hispanics having lower levels of health literacy than whites (Gazmararian et al., 1999).

1.3.3 The Impact of Low Health Literacy on Health Outcomes

Health literacy involves not only the comprehension of health information, but also the confidence to take action to improve health outcomes (Nutbeam, 1998). However, written health information aimed at consumers is often too complex for the average American adult to understand and contain jargon which can be incomprehensible even for those with high literacy (Kindig et al., 2004). The mismatch between the literacy skills of consumers and the literacy demands of the health material therefore inhibits their understanding and decision making processes (Kindig et al., 2004). Understandably, consumers who have not understood the health information they have read would have little confidence to act. Consequently, health information which is not understandable has no benefit (Laplante-Lévesque & Thorén, 2015) and results in negative health consequences for patients who need to adhere to complex health care instructions (Horner et al., 2000).

Low health literacy has been associated with poorer self-reported overall health (Kutner et al., 2006), poorer health outcomes, and reduced use of screening services (Berkman et al., 2011; McCray, 2005; Scott et al., 2002). Consequently, individuals who do not use preventive-care services have higher healthcare and medication costs (Zamora & Clingerman, 2011). Low health literacy can also result in medication errors (Zamora & Clingerman, 2011) and higher rates of hospitalisation (Baker et al., 2002). Concerningly, those with the lowest levels of health literacy had the highest mortality rate (Wolf et al., 2010).

1.3.4 Improving Health Literacy

Improving health literacy has therefore become a priority around the world. The European Health Literacy Survey conducted between 2009- 2012 showed that on average, every second person surveyed had limited health literacy (Sørensen et al., 2015). An urgency was thus felt to improve the population's health literacy in order to benefit their health (Sørensen et al., 2015). In the US, the imperative need to improve health literacy resulted in the formation of the National Action Plan to Improve Health Literacy (Office of Disease Prevention and Health Promotion, 2010). Integral to its goal was to transform the way health information was presented and disseminated (Office of Disease Prevention and Health Promotion, 2010). Outcomes of improved health literacy include the adoption of healthy behaviours, increased use of preventative services, and better management of acute and chronic diseases (Chesser et al., 2016). In addition to achieving better health outcomes, increased health literacy will also result in reduced healthcare costs (Chesser et al., 2016).

Health literacy can be improved when the complexity of health information is equally matched with the skills and abilities of the individual (Institute of Medicine, 2009; Parker & Ratzan, 2010). Improving health literacy is therefore a two sided strategy which involves improving consumers' knowledge as well as simplifying the health care system to increase its

accessibility (Parker & Ratzan, 2010). Health information can be made more accessible through making literacy adjustments to the text for increased reading comprehension (Kelly-Campbell & Manchaiah, 2020). These adjustments may include using short sentences and simple, familiar words instead of complex words (Beukes et al., 2020). Consequently, health literacy is linked to the concept of readability (Freda, 2005).

1.4 Readability

1.4.1 Definition of Readability

Readability is defined as "the ease with which a person can read and understand written materials" (Freda, 2005). Readability is measured through readability formulae which mathematically calculate the reading grade level (RGL) of the text. An individual's RGL is approximately equal to the number of years' education the individual received in the US education system (Doak et al., 1996). The RGL can only give an approximate measure of how comprehensible the text is for an individual because some individuals' RGL can be four or five years below their stated years of schooling (Doak & Doak, 1980).

Various studies have sought to identify the ideal RGL range which would give readers the greatest likelihood of comprehension. Davis et al. (1996) suggested that the RGL for health information should be between third and fourth grade whilst Doak et al. (1996) recommended a RGL of fifth to sixth grade. The American Medical Association recommended that health information aimed at older adults, non-native speakers or individuals with limited education be written at third to fifth RGL, whilst in other circumstances, fifth to sixth RGL should be used (Weiss, 2003). Nevertheless, lower RGL materials were preferred by readers of all health literacy levels as they were quicker and simpler to comprehend (Doak et al., 1996).

1.4.2 Measures of Readability

Readability is measured through readability formulae which mathematically determine the RGL of texts by assessing aspects such as the average number of syllables per word, the number of words per sentence and the percentage of familiar words used (Ihler & Canis, 2019). There are over 200 different readability formulae (Kelly-Campbell & Manchaiah, 2020) and each uses a different set of criteria to indicate RGL (Wang et al., 2013).

The Flesch Kincaid Grade Level (F-K) and the Flesch Reading Ease (FRE) are the two most commonly used tools in assessing the readability of health information websites (Daraz et al., 2018). The F-K directly estimates reading grade levels and is more commonly used than the FRE, which provides a reading ease score (Wang et al., 2013). The Simple Measure of Gobbledygook (SMOG) formula is considered the gold standard for evaluating health care material, because it is the only formula which predicts 100% comprehension (Fitzsimmons et al., 2010; Meade & Smith, 1991; Wang et al., 2013). The Gunning Fog Index (FOG) correlates closely with the SMOG formula (Friedman & Hoffman-Goetz, 2006). The mathematical formulae for the four readability formulae used in this study are outlined below.

The F-K formula, developed by Kincaid (1975) is a modified version of the FRE and directly estimates the RGL (Friedman & Hoffman-Goetz, 2006). The mathematical formula for the F-K, according to Kincaid (1975) is:

RGL = (0.39 x average number of words per sentence) + (11.8 x average number of syllables per word) – 15.59.

The FRE gives a reading ease score, with 0 indicating a very difficult reading level and 100 indicating a very easy reading level (Flesch, 1948). The FRE formula assesses at

least three 100-word passages from the text, analysing them for the average number of words per sentence and the average number of syllables per word (Flesch, 1948). According to (Flesch, 1948), the mathematical formula for calculating the Flesch Reading Ease is:
FRE = 206.835 – (846 x average number of syllabus per 100 words) – (1.015 x average number of words per sentence).

The SMOG estimates RGL by assessing the number of words with at least three syllables (McLaughlin, 1969). Lower scores on the SMOG indicate easier readability (Laplante-Lévesque et al., 2012). The SMOG is one of the easiest formulas to use and is based on more recent criteria for deciding reading grade level (Wang et al., 2013). Its mathematical formula according to McLaughlin (1969) is:
RGL = 3 + the square root of the number of words with 3 or more syllables per 30 sentences. The 30 sentences should be three sets of 10 consecutive sentences, located at the beginning, middle and end of the document (McLaughlin, 1969).

The Gunning Fog Index is calculated using average sentence length and number of complex words (Gunning, 1952). Its formula is expressed as: RGL = 0.4 (*sl* + % *lw*) where *sl* refers to the average number of words per sentence and % *lw* refers to the percentage of words which are three or more syllables long (Gunning, 1952). However, Gunning (1952) stated that the FOG formula does not include certain long words in the calculation.

Readability formulae are validated against texts from the McCall-Crabbs Standard Test Lessons in Reading, which is considered the gold standard for assessing comprehension (Wang et al., 2013). It consists of word passages of increasing difficulty levels, with multiple-choice comprehension questions at the end of each passage (Wang et al., 2013). Each readability formula has different criteria for estimating the reader's RGL. A comprehension score of 75% is required for the FRE formula (Flesch, 1948) and F-K formula (Kincaid et al.,

1975). However, the SMOG requires 100% comprehension (McLaughlin, 1969) and the FOG requires 90% comprehension (Gunning, 1952).

Readability formulae can give more accurate predictions of readability when they are used together as a battery of tests (Beaunoyer et al., 2017). The suggested battery of tests includes the SMOG, FRE, F-K and FOG as these are the optimal tools to assess readability of online health information (Beaunoyer et al., 2017). The FRE, FOG and SMOG are known to give almost identical results for the same texts, however the F-K gives a lower estimate (Ley & Florio, 1996). A study showed that the F-K underestimated the RGL by 1.65 grades compared to the SMOG formula (Sharma et al., 2014) whilst another study showed that the F-K underestimated the RGL by two to three grades compared to the SMOG formula (Freda, 2005). When using multiple formulae together, either the highest calculated RGL should be selected, or the average RGL obtained from the results (Friedman & Hoffman-Goetz, 2006; Ley & Florio, 1996). However, other researchers have suggested using only a single readability formula such as the SMOG (Meade & Smith, 1991).

1.4.3 Readability of Health Related Information on the Internet

Hearing-related information on the internet has high RGLs which exceed the recommended level of fifth to sixth grade (Manchaiah et al., 2019). Another study showed that the RGL of some webpages even exceeded eighth-grade (Squires & Ou, 2020). Squires and Ou (2020) found that 76.5% of the material on ARHL provided by communication sciences and disorders organisations on the internet had a mean RGL of 9.37 according to the F-K formula and a mean RGL of 10.97 according to the SMOG formula. Findings from one review showed that hearing-related information on the internet had mean F-K RGLs of 9 to 13.6 (Laplante-Lévesque & Thorén, 2015). Another review reported a mean F-K RGL of 10.1 to 11.8 (Manchaiah et al., 2020). Similarly, an investigation of the readability of articles

on hearing loss on Wikipedia showed that 66% of the articles had a F-K RGL of 13 or above, (Simpson et al., 2018).

Because the average RGL of American adults is eighth grade (Brega et al., 2015) or in the region of seventh to eighth grade (Manchaiah et al., 2019), the majority of hearing-health information on the internet is therefore too difficult for the average American adult to understand. Concerningly, 95% of tinnitus websites in a study exceeded the RGL of the average US adult according to the F-K formula (Manchaiah et al., 2019). Distributing health information which is too difficult to understand is futile (Squires & Ou, 2020), however, information which is easy to read results in better comprehension and improved compliance with the instructions (Bradshaw et al., 1975). It is therefore imperative that health information is written in a manner that is comprehensible for consumers.

1.4.4 Limitations of Readability Formulae

Despite their benefits, readability formulae have their limitations. The accuracy of the predicted RGL can be affected by the sample size of the text and its formatting (Friedman & Hoffman-Goetz, 2006), therefore RGL estimations should be accompanied with further information about the sample size, location of the sample within the text, format of the text and type of word processing software (Bohanny et al., 2013). Readability formulae also do not consider readers' existing knowledge of the topic or level of motivation (Bailin & Grafstein, 2001). As readers' comprehension can be affected by issues such as anxiety levels or environmental factors such as distractions (Estey et al., 1994; McCray, 2005), readability formulae cannot predict the level of comprehension. In fact, readability is only one of the many elements which affects reader comprehension (Freda, 2005). Suitability factors, for example layout, graphics and use of active language also play a major role in influencing readers' understanding (Doak et al., 1996).

1.5 Suitability

1.5.1 Definition of Suitability

Suitability is an important element in written health information which helps to predict the extent to which the information will be understood (Nasser et al., 2012) and accepted by the target audience (Vallance et al., 2008). The factors which constitute the suitability of written material are content, language, graphics, layout, and typography, learning and motivation, and cultural appropriateness (Doak et al., 1996) The suitability of written material can be improved by ensuring that its content, design, and readability match the cognition and health literacy of the target audience (Doak et al., 1996). The appeal of the material can be affected by its suitability. For example, material which uses images which are relevant to the age of the target population will be more appealing to its target audience (Friedman & Hoffman-Goetz, 2006). It is essential to consider suitability when developing written material because well-designed information is preferred by readers of high and low health literacy (Caposecco et al., 2011). Furthermore, well-designed material requires less working memory for decoding the information and this results in improved comprehension (Wilson & Wolf, 2009).

1.5.2 Measures of Suitability

The Suitability Assessment of Materials (SAM) developed by Doak et al. (1996) is a systematic tool for assessing the suitability of patient education materials. Its advantage is that it can be used by the researcher without requiring a sample of the target population to be present (Doak et al., 1996). Although it was originally designed to be used with printed material, it has also been applied to video and audiotaped material (Doak et al., 1996). The SAM tool is the most widely used amongst rating scales which assess the content and design of written materials, (Doak et al., 1996). It has been used extensively in research on the suitability of written health-care materials (Caposecco et al., 2011) and has also been

validated by health care providers from several different cultures (Doak et al., 1996).

The SAM tool evaluates six aspects of the material for suitability: 1) content, 2) literacy demand, 3) graphics, 4) layout and typography, 5) learning stimulation and motivation and 6) cultural appropriateness (Doak et al., 1996). Each aspect is further divided into a number of factors, resulting in a total of 22 possible factors. Using the SAM criteria which was provided by Doak et al. (1996), each factor can be rated as 'not suitable', 'adequate' or 'superior', using the scoring system of 0, 1 or 2, respectively. Factors which are not applicable are not scored and the total possible score adjusted accordingly. Upon completion, the scores are totalled and converted to a percentage, with 70 – 100% indicating 'superior material', 40 – 69% signifying 'adequate material' and 0 – 39% revealing that the material is 'not suitable' (Doak et al., 1996). The criteria for a 'superior' score are shown in Table 1.

Table 1. *SAM Evaluation Criteria*

Factor	Requirements for a 'superior' score
Content	The purpose is clearly conveyed in the title, cover illustration or introduction. The content encourages the reader to take desirable action, whilst the scope is appropriately limited. A summary is included.
Literacy demand	The RGL is 5th grade or lower. The text has simple sentences, common words, uses a conversational style and active voice. Technical terms which are used are explained. Sentences have the context provided first and new topics are preceded by headings.
Graphics	The cover graphic attracts attention and conveys the purpose of the material. Illustrations are relevant and in the form of simple line drawings. Explanatory captions are included for the graphics.
Layout and typography	Five or more factors need to be present for a superior score. Examples of the desirable layout factors include: • Illustrations are next to the relevant text. • Layout is consistent and easy to follow. • Boxes and arrows direct reader's attention • Clear, uncluttered presentation. • Colour helps to support the message. • Line length of 30-50 characters and spaces. • High contrast between text and background. Text should also be size 12 or larger, and without continuous use of upper case letters. Bolding or colour are used for emphasis and lists are grouped under subheadings.
Learning stimulation and motivation	The reader is given questions to consider. Desirable behaviours are modelled in the material and motivation is maintained by divided text into short, manageable sections.
Cultural appropriateness	The cultural content is similar to the readers'culture. The target culture is presented positively through the images.

Note. SAM Evaluation Criteria adapted from Doak et al. (1996)

According to Doak et al. (1996), 'unsuitable' ratings indicate deficiencies in the material, which should be removed through revision. However, if the material has already been published and unable to be changed, supplementary explanations should be provided instead (Doak et al., 1996). Material which is rated as "unsuitable" in its readability or cultural appropriateness should be considered as unsuitable, regardless of its overall rating (Doak et al., 1996). This is because information which is too difficult to read will not be understood, and material which inappropriately portrays the target audience's culture will be rejected (Doak et al., 1996).

1.5.3 Suitability of Hearing- Health Information

There are limited studies on the suitability of hearing-health related information. A review by Manchaiah and Kelly-Campbell (2020) found that the majority of existing hearing aid user guides had limited suitability. Squires and Ou (2020) reviewed internet-based information on ARHL by communication disorders organisations, which were available for viewing by the general public. Their findings showed that the majority of the material had 'adequate' suitability and the rest were classified as 'not suitable'. Common issues which led to an unsuitable rating for individual factors included the lack of summaries, RGL of ninth grade or above, use of difficult vocabulary and lack of subdivision of complex topics (Squires & Ou, 2020).

Previous studies have found that hearing-related material which is unsuitable or merely 'adequate' can be improved to a 'superior' level through adhering to best practice guidelines (Caposecco et al., 2016; McMullan et al., 2018; Ming & Kelly-Campbell, 2018). Material which was developed to a 'superior' suitability level was easy to understand and enabled participants to complete the assigned tasks more quickly, without the need for further help (Caposecco et al., 2016). Similarly, participants who had read a highly suitable revised tinnitus brochure found it easier to understand, more appealing and more helpful than the unrevised brochure (Ming & Kelly-Campbell, 2018). Health education materials often require readers to change aspects of their health behaviours in order to attain better outcomes. The degree of change an individual is prepared to exert is dependent on his or her self-efficacy.

1.6 Self-Efficacy

1.6.1 Definition of Self-Efficacy

Self-efficacy is the belief or confidence an individual has in his or her ability to behave in a manner which produces the desired outcome (Bandura, 1977, 1986). Self-efficacy is context dependent and domain specific, therefore an individual may experience

high self-efficacy in a certain domain of life but simultaneously have low self-efficacy in other areas (Bandura, 1977; Smith & West, 2006). Individuals' engagement in certain behaviours, for example health-related behaviours are influenced by their perceived level of self-efficacy in that area (Bandura, 1977, 1997).Thus, individuals are likely to only involve themselves in activities which are within their perceived capabilities (Bandura, 1977; Schunk, 1990). Higher self-efficacy will lead to a greater output of effort and perseverance in that domain (Bandura, 1977, 1986, 1997; Schunk, 1990). Low self-efficacy has been associated with low health literacy, (Mackey et al., 2016; Zuercher et al., 2017) low income and minority ethnicities (Shulman et al., 2019).

Successes experienced by individuals will further reinforce and strengthen self-efficacy levels, however repeated failures will lower individuals' expectations of success (Bandura, 1977, 1986). Fortunately, the negative impact of occasional failures can be reduced when the individual also experiences repeated successes (Bandura, 1977, 1986). In particular, success which occurs with minimal effort results in greater self-efficacy, because it causes individuals to rate their ability highly in that area (Bandura, 1977). Evidence of progress is another important factor for developing self-efficacy (Schunk, 1996). Individuals who perceive that they are making progress despite setbacks will develop a greater sense of self-efficacy than those whose performances have levelled compared to their previous progress rate (Bandura, 1977).

Self-efficacy is based on four sources of information: performance accomplishments, vicarious experience, verbal persuasion, and physiological and affective states (Bandura, 1977, 1997). Performance accomplishment is the strongest influencer of self-efficacy (Bandura, 1977). Vicarious experience involves observing others perform the task. Watching others succeed builds an expectation in the individual that he or she can also succeed in the same way (Bandura, 1977). Verbal persuasion involves convincing the individual that he or

she is capable of the task. It is particularly effective when given by a significant other, and accompanied by realistic and detailed feedback (Bandura, 1977). Finally, physiological and affective states affect self-efficacy because individuals are unlikely to expect success when they are highly stressed (Bandura, 1977, 1997).

1.6.2 Relationship between Self-Efficacy and Help-Seeking

Individuals with high self-efficacy levels have a greater tendency to seek help than those with low self-efficacy levels (Lim et al., 2014; Nelson & Ketelhut, 2008; Tan et al., 2008; Williams & Takaku, 2011). Help-seeking was found to be positively correlated with general self-efficacy as well as with self-efficacy for self-regulation (Pajares et al., 2004). Through effective self-regulated learning, individuals with high self-efficacy were able to self-identify their need for help and thus seek assistance (Lim et al., 2014).

High self-efficacy removes the barriers against participating in discussions with professionals (Heckman et al., 2011; Maliski et al., 2004) thus making it easier for individuals to obtain help when facing obstacles they could not overcome alone. Other factors which positively influence help-seeking are previous positive experiences with help-seeking and the availability of a supportive social network (Rickwood et al., 2005). Notably, these factors are also sources of self-efficacy (Bandura, 1977, 1997). Because high self-efficacy increases the amount and duration of effort spent on a task (Bandura, 1977, 1997; Schunk, 1990), individuals with high self-efficacy would choose to obtain help, rather than abandon the task when faced with difficult challenges. As a result, individuals with high self-efficacy are better able to plan and achieve their goals (Tye-Murray, 2020).

1.6.3 Relationship between Self-Efficacy and Health Outcomes

High self-efficacy levels are associated with better health outcomes, higher quality of life (Chirico et al., 2017; Eller et al., 2018; Heckman et al., 2011), reduced depression (Qian

& Yuan, 2012) and more effective self-management behaviours (Ludman et al., 2013; Sarkar et al., 2006). In patients with chronic conditions, self-efficacy for self-care was associated with less symptom distress and better coping skills (Eller et al., 2018). This was consistent with findings from a randomised control trial where participants with high self-efficacy were more effective in managing their condition and maintaining lifestyle changes (Ludman et al., 2013). High self-efficacy is associated with better communication between patient and physician (Heckman et al., 2011; Maliski et al., 2004; Maly et al., 2009). Patients who had high self-efficacy for informing their physician of their symptoms had greater symptom resolution than those who had low self-efficacy (Heckman et al., 2011; Maly et al., 2009).

Patients with high self-efficacy for discussing their concerns with their physician therefore experienced greater satisfaction and increased confidence in their health providers (Maliski et al., 2004). This also applies in audiological rehabilitation, as individuals with high self-efficacy succeed in managing their hearing loss more effectively and thus have better outcomes (Smith & West, 2006). Individuals with high self-efficacy for hearing aid management are more inclined to participate fully in activities whereas those with low self-efficacy are more likely to restrict their participation (Smith & West, 2006). This is consistent with Bandura's theory that highly self-efficacious individuals persist even when encountering obstacles (Bandura, 1977, 1997).

1.7 Revision of Health Information

As mentioned earlier, the majority of patient education materials are written at a higher RGL than the average American is capable of understanding. There is therefore an essential need to revise the information and reduce its associated literacy demands. It is important that health information can be easily read, understood, and remembered, because only then is it effective (Hoffmann & Worrall, 2004). Following revision, information can be

made more understandable by pilot testing and obtaining feedback from the target audience, to reveal any misinterpretations (Vahabi & Ferris, 1995).

Various revisions of health materials have been carried out in audiology as well as in other fields, including ophthalmology (Williams et al., 2016), vaccines (Davis et al., 1996) and cancer education (Hunter & Kelly, 2012; Permuth-Wey et al., 2010; Vadaparampil et al., 2011). The inclusion of participants' feedback in some of these revisions enabled researchers to discover aspects which the target audience considered to be important. Interestingly, these mirrored guidelines for revising material which had been proposed by researchers. Participants stated that it was important to emphasise important points, use simple language and provide practical tips (Williams et al., 2016). In another study, participants recommended limiting the scope, using simple vocabulary, and choosing appropriate images for the target audience (Permuth-Wey et al., 2010). Likewise, the participants in the study by Vadaparampil et al. (2011) also stressed the importance of explaining difficult words clearly, choosing familiar words and making the information relevant to the target audience. Because people of all literacy levels prefer information to be presented to them simply, (Doak et al., 1996), revising health information would be beneficial for everyone.

1.7.1 Best Practice Guidelines

Best practice guidelines are strategies which can be used when writing and designing health materials in order to ensure that the material is easily understandable by the target audience. Steps to successfully revise material for improved comprehensibility and actionability have been outlined by various researchers such as Caposecco et al. (2011), Doak et al. (1996), Hoffmann and Worrall (2004) and organisations such as the National Cancer Institute (1994) and the Centers for Disease Control and Prevention (2009). For example, a strategy to make material more comprehensible is to organise it under headings and subheadings, with the most important points being stated first (Boyd, 1987).

Comprehensive and detailed best practice guidelines were provided by Doak et al. (1996). In the guidelines, Doak et al. (1996) outlined three main steps in the revision process: planning, writing, and testing. In the planning stage, the reviewer should define the target audience, decide on the purpose of the material, and consider how to achieve audience interaction (Doak et al., 1996). Other researchers and organisations have also emphasised the importance of defining the target audience in order to better tailor the material to their needs (Bernier, 1993; Centers for Disease Control and Prevention, 2009; National Cancer Institute, 1994). For example, the target audience in a study by Horner et al. (2000) had a RGL of fifth grade and spoke English as a second language. The information was thus accordingly written to be fifth grade RGL, with English and Spanish information appearing side by side on the page, to aid comprehension (Horner et al., 2000).

Secondly, in the writing stage, sentence construction and choice of words should be considered. For instance, the writing should be in active voice, conversational style and with short sentences and familiar words instead of jargon (Doak et al., 1996).The use of short sentences and active voice have also been recommended by the Centers for Disease Control and Prevention, (2009) and the National Cancer Institute, (1994). Examples and explanations for complex concepts should be given to aid reader's understanding (Doak et al., 1996).

The final stage involves testing through learner verification, which should ideally be done before the material is published (Doak et al., 1996). Due to differences in vocabulary and levels of reasoning between health professionals and the general public, it is necessary for learner verification to occur, as this can illuminate reader misinterpretations (Doak et al., 1996; Hunter & Kelly, 2012). Doak et al. (1996) suggested having a sample size of 30 to 50 participants to test material which will be distributed nationally, and 10 participants for material which will be distributed locally. Following participant interviews and changes to the material, a second interview session should be conducted to ensure that any

misunderstandings, particularly those pertaining to purpose, key points, self-efficacy, and culture, have been resolved (Doak et al., 1996). Participants' views should be obtained on the material's key points, potential weaknesses and its five influential qualities: attraction, comprehension, self- efficacy, cultural appropriateness, and persuasion (Doak et al., 1996).

The first quality – attraction, is important because the audience should feel sufficiently drawn to the material (Doak et al., 1996). In a study by Meltzer et al. (2018) on developing an educational tool for smoking cessation, the researchers increased the attraction of the material by changing the images as a response to participants' suggestions. The second influential quality - comprehension, can also be improved through the use of images (Meltzer et al., 2018). Thirdly, self-efficacy can be assessed by asking readers whether they required further instructions to carry out the task (Doak et al., 1996). Self-efficacy can be enhanced through providing practical tips as demonstrated in a revision of a tinnitus brochure (Ming & Kelly-Campbell, 2018) and in a revised ophthalmology patient handout (Williams et al., 2016).

Fourthly, cultural appropriateness can be increased by involving people from the target culture in the designing of the material. For example, Dowse and Ehlers (2001) found that pharmaceutical pictures designed by local Africans in South Africa were strongly preferred by locals with low literacy, compared to standardised pictures designed in the US. The pictures designed by locals also led to greater comprehension of the message than the standardised pictures (Dowse & Ehlers, 2001). Finally, persuasiveness can be enhanced by appealing to the desires of the target audience. For example, the target audience in the study by Meltzer et al. (2018) liked to feel in control, and therefore the researchers emphasised the theme of being in control whilst abstaining from smoking.

1.7.2 Revision of Hearing-Related Health Information

Researchers have utilised best practice guidelines to develop revised hearing health information which is easily readable and comprehensible. Caposecco et al. (2016) revised an existing hearing aid user guide by using techniques such as reducing its content to contain only necessary information, lowering its RGL to a mean of 4th grade and enlarging the guide for visual clarity. Each change implemented in the revision by Caposecco et al. (2016) had been shown in previous studies to be effective in improving comprehension. Such changes include deliberately limiting the scope of the material as this can lead to better recall of the information (Bernier 1993). As a result, the participants who used the revised guide were more able to perform the tasks accurately without requiring further help (Caposecco et al., 2016).

In another study, Caposecco et al. (2011) defined the target audience (older adults) before developing the material. Due to the target audience being older adults, Caposecco et al. (2011) set the RGL at 3.5, which is within the recommended range for older adults (Weiss, 2003). Efforts were also made to ensure that there was visual clarity throughout the material. For example, the simple graphics were accompanied by large black arrows to direct the readers' attention to important aspects of the image. The hearing aid instructions attained a 'superior' suitability score and was also pilot tested, as recommended by Doak et al. (1996). The participants were able to follow the instructions easily, (Caposecco et al., 2011) thus showing that they felt self-efficacious for the task (Doak et al., 1996).

As recommended by Doak et al. (1996), participant feedback is important when developing health material. Donald and Kelly-Campbell (2016) incorporated participants' suggestions into their revision and this resulted in the addition of a glossary and website links to their revised paediatric report (Donald & Kelly-Campbell, 2016). Similarly, Ming and Kelly-Campbell (2018) revised a tinnitus brochure and included participants' requests for

practical tips, contact details and relevant images to be added. As a result, of these revisions, both studies showed that participants who had read the revised version had higher comprehension and self-efficacy (Ming & Kelly-Campbell, 2018).

1.8 Study Rationale

Health information which is not understandable is ineffective (McMullan et al., 2018). Information targeted at older adults needs to be easily readable as two out of five older adults read at fifth reading grade level or below (Doak et al., 1996). Furthermore, increasing age is associated with lower health literacy (Cutilli, 2007), and adults age 65 years and over have poorer health literacy than younger age groups (Gazmararian et al., 1999). This highlights the need to improve the readability of health information, especially when older adults are the target audience.

Health information which lacks good readability and suitability can be successfully revised to have a lower RGL (Davis et al., 1996; Horner et al., 2000) and greater suitability (Ming & Kelly-Campbell, 2018; Williams et al., 2016). Many researchers and organisations have provided best practice guidelines covering a range of aspects including language, content, and layout (Bernier, 1993; Doak et al., 1996; Hoffmann & Worrall, 2004; National Cancer Institute, 1994). Health information which had been revised according to best practice guidelines resulted in significantly higher comprehension and self-efficacy in readers (Donald & Kelly-Campbell, 2016; McMullan et al., 2018; Ming & Kelly-Campbell, 2018).

As self-efficacy is essential for achieving behaviour change, it is vital that patient education material promotes self-efficacy as this is associated with improved health outcomes (Chirico et al., 2017; Cunningham et al., 1991; Robinson-Smith et al., 2000). Unfortunately, barriers such as low health literacy prevent many readers from accessing and understanding health information, which limits their self-efficacy. However, by providing patient education

materials which are suitable and easy to understand, barriers such as low health literacy will be overcome and accessibility to health information will be increased.

To the researcher's knowledge, no study to date has revised a webpage on ARHL. Furthermore, no study has assessed readers' comprehension and self-efficacy after reading a revised webpage on ARHL, compared to an unrevised webpage. Unmanaged ARHL has many detrimental effects and thus it is necessary to develop ARHL information which is comprehensible and motivates the reader to act. With the increasing of state pension ages around the world to account for increased life expectancies, many older workers might need to remain in the labour force for several more years (Mercer, 2020; Oxlade, 2017). Managing hearing loss will reduce communication difficulties and improve quality of life (Mulrow et al., 1990) thus making it more possible to perform optimally in the workplace and maintain earning potential (Jung & Bhattacharyya, 2012). As the benefits of managing hearing loss are bountiful, it is imperative to develop educational materials which empower individuals to act on managing their hearing loss.

1.9 Aims and Hypotheses

This study aimed to revise a commercial webpage on ARHL to improve its readability and suitability, with the intention of increasing reader comprehension and self-efficacy. Readability of the unrevised and revised webpages will be assessed by using readability formulae. Similarly, suitability will be assessed by using the SAM tool (Doak et al., 1996). Comprehension and self-efficacy will be assessed through multiple-choice questions delivered after the participants have been randomly assigned to read either the unrevised or revised webpage. Previous studies have found that reading revised material improved comprehension (Baker et al., 1988; Meade et al., 1989; Young et al., 1990) whilst more recent research showed that it improved both comprehension and self-efficacy (Donald &

Kelly-Campbell, 2016; Ming & Kelly-Campbell, 2018). Therefore, the following null hypotheses were proposed:

1) There will be no significant difference in comprehension between the unrevised and revised groups.

2) There will be no significant difference in self-efficacy between the unrevised and revised groups.

3) Comprehension will not be significantly correlated with self-efficacy.

4) Self-efficacy will not be significantly correlated with age.

5) Comprehension will not be significantly correlated with age.

CHAPTER TWO: METHOD

2.1 Overview

A webpage on ARHL was revised for improved readability and suitability, using best practice guidelines. Next, participants were randomly allocated to read either the unrevised or revised version and their comprehension and self-efficacy were assessed through a survey questionnaire administered on Qualtrics – an online survey software. Prior to commencing this study, ethical approval was granted from the Human Ethics Committee at the University of Canterbury, New Zealand on the 14th of February 2020 (Appendix A).

2.2 Participants

The sample size for the study was determined through G* Power software, version 3.1.9.2, before participant recruitment began. G*Power analysis showed that a sample size of 8 participants was required in each of the two groups, to detect a partial eta squared of 0.2 (power = 0.8, alpha = 0.5). However, the researcher aimed to obtain 20 participants for each group so that the Central Limit Theorem could be applied. Participants were recruited using a snowball recruitment method. The advertisement for study participants was placed on Facebook and on community noticeboards in libraries and supermarkets in Christchurch, New Zealand. Colleagues and associates of the researcher who were eligible to participate were also emailed and informed about the study.

To be eligible to participate in the survey, participants had to be (1) between the ages of 50 to 65 years old, (2) never had a hearing test as an adult and (3) able to read in the English language. The age criterion was chosen because the first symptoms of ARHL become noticeable between the ages of 50 to 65 years (Nash et al., 2011). Therefore, individuals are more likely to seek information about ARHL when they are within that age bracket. The second criterion was chosen because individuals who have had a hearing test might have gained knowledge about hearing loss through discussion with their hearing-health provider. If

such participants were included in the survey, their answers might be influenced by their existing knowledge and therefore would not be a true representation of their reading comprehension and self-efficacy.

2.3 Selecting a Webpage on ARHL

A webpage entitled “Everything you need to know about presbycusis” from a commercial website ‘hear.com’ was selected for revision. It was a good representation of a typical webpage on hearing-health in terms of readability and suitability characteristics. The chosen webpage had a RGL of 11.4 according to the F-K formula. As the range of RGLs for hearing related information on the internet is 9th to 14th grade, (Laplante-Lévesque & Thorén, 2015), the chosen webpage therefore had a RGL which fitted within the typical range. In terms of suitability, the webpage had an ‘adequate’ rating and similar characteristics to other webpages on hearing-health, such as the use of difficult vocabulary and the lack of a summary (Squires & Ou, 2020). A commercial webpage was selected because 64% of existing websites are commercial websites (Laplante-Lévesque et al., 2012), and thus commercial websites have a high likelihood of being viewed by health consumers.

2.4 Evaluating Readability and Suitability

Readability was measured in the same manner for both the unrevised and revised webpages. To assess readability, the text from each webpage was extracted and imported into an online readability calculator (WebFx, n.d). The RGLs according to the F-K, FRE, FOG and SMOG formulae were obtained from the online readability calculator, as well as additional readability features such as ‘average number of syllables per word’, and ‘number of complex words’. Next, the text of each webpage was imported into Microsoft Word version 365 which gave further readability statistics such as ‘percentage of passive sentences’.

Suitability was assessed in the same manner for both the unrevised and revised webpages. The suitability of each webpage was evaluated by the researcher and two Master of Audiology students from the University of Canterbury, using the SAM criteria (Doak et al., 1996). According to the SAM criteria, each factor received 0 points if it was 'not suitable', 1 point if it was 'adequate', and 2 points if it was 'superior'. For both the unrevised and revised webpages, one factor regarding Cultural Appropriateness was not applicable, therefore 2 points were removed from the total possible score. Each researcher summed the scores from the 21 factors to obtain the overall SAM score. This was then converted to a percentage.

An intraclass correlation coefficient (ICC) was calculated for the scores given by the three raters, using the Statistical Package for the Social Sciences, Version 26 (SPSS 26). This calculation was performed to determine the extent of inter-rater reliability. Next, the median (derived from the scores from the three raters) for each of the 21 SAM factors was calculated for the unrevised and revised webpages. These were then summed to give the total SAM score for each webpage. Finally, the total SAM score for each webpage was converted to a percentage.

2.5 Revising the Webpage

The webpage was revised according to best practice guidelines which have been shown in previous studies to give better comprehension and actionability (Caposecco et al., 2011; Doak et al., 1996; McMullan et al., 2018). As recommended by Doak et al. (1996) the following six factors were revised: content, literacy demand, graphics, layout, and typography, learning stimulation and motivation, and cultural appropriateness. Table 2 lists some examples of the changes the researcher made whilst revising the material.

Table 2. *Examples of Changes Made During the Revision*

Factor	Changes made in the revised version
Content	• The purpose of the material was clarified by replacing the original title 'Everything you need to know about presbycusis' with 'Hearing loss in older adults'. • Two summaries were included in the revised webpage.
Literacy demand	• The material was revised until it reached an RGL of F-K 4.7. • Short, common words were used. For example, "high frequency range" was replaced with "high pitched sounds". "Ototoxic medication" was replaced with "medicines and drugs which can cause hearing loss". • Important information, for example "Do you have hearing loss?" was framed in a box to direct the reader's attention to it.
Graphics	• The original cover graphic of a leaf was changed to an image of a group of older adults conversing, in order to better convey the purpose of the material. • Other images accompanied by captions were added. These were a colour coded line drawing of the ear, a clinician using an otoscope to view a client's ear and different styles of hearing aids being worn. • The audiogram was accompanied by a caption and an explanation on how to interpret it.
Layout and typography	• An uncluttered look was achieved by leaving plenty of white space. Size 14, black 'Times New Roman' serif font was used. • Subheadings were used, with further subdivisions within each section. For example, the subheading 'What happens in a hearing test?' was then subdivided into 'Your hearing test, part 1','Your hearing test, part 2' and a summary.
Learning stimulation and motivation	• Interaction was achieved through including a quiz and also by question-style subheadings, for example "Why am I losing my hearing?" and "How do I know if I have a hearing loss?"
Cultural appropriateness	• The cover image positively portrayed the target audience (people age 50 to 65 years) enjoying a conversation together. • Images should reflect the target audience (Friedman & Hoffman-Goetz, 2006) and therefore a photo of an older adult having a hearing check was included.

The researcher also referred to the Federal Plain Language Guidelines (US Plain Language Action Information Network, 2011) whilst revising the webpage. These guidelines recommended the use of personal pronouns to help create a conversational flow to the text. For example, the revised webpage asked, “Are you age 50 or over?” Examples of the Plain Language Guidelines used are shown in Table 3.

Table 3. *Examples of Plain Language Guidelines Used in the Revision*

Plain Language Guidelines (US Plain Language Action Information Network, 2011).
Use personal pronouns (for example, ‘you’).
Use active verbs.
Aim for only 15 to 20 words per sentence.
Use question and answer headings.
Highlight key facts.
Use common words.
Break up the text with bullet points, images, informative headings.

Permission has been obtained to use the Plain Language Guidelines (Appendix I).

The completed revision was then shown to the supervisor of this study who recommended a few minor changes to improve its accuracy. The revision was also shown to the two student researchers who suggested some changes to the formatting and layout (for example keeping the font and colours of the headings consistent and using more bullet points for emphasis). These changes were implemented by the researcher. After the revision had been completed, the revised webpage was assessed for readability and suitability as described in 2.4.

2.6 Assessing Participants’ Comprehension and Self-Efficacy

An online survey was created using Qualtrics Survey Software 2020. Both the unrevised and revised versions of the webpage were imported into Qualtrics as pdf files. The survey flow was programmed so that it would alternately present either the unrevised or revised webpage to the participants, followed by the questions assessing comprehension and

self-efficacy. This enabled participants to be randomly allocated either an unrevised or a revised version. After a participant finished reading the material, he or she was requested to click a box to be taken to the questions page. Once on the questions page, the participant would be unable to go back to the previous pages to reread the material. This was done to ensure that all participants read the material a similar number of times (in this case, once) and did not refer back to the material to locate answers, as this would affect their results.

Prior to starting the survey, participants read the study's information page on Qualtrics and clicked a box to confirm that they met the eligibility criteria and consented to participate. Next, they completed the demographical questions on the following page. Participants were then requested to answer five multiple-choice comprehension questions and two multiple-choice self-efficacy questions. The same questions were presented to all participants, regardless of whether they read the unrevised or revised version. All of the questions had to be answered in order for the survey to be considered complete. Participants were offered a chance to enter a draw to win one of two USD 50 Amazon gift cards at the conclusion of the survey.

2.7 Measures

The measures involved in this study were RGL (measured using the F-K, FOG, FRE and SMOG formulae), SAM scores, comprehension scores and self-efficacy scores. Each participant was required to answer five multiple-choice comprehension questions. One example of a comprehension question in the study is: "What is an early symptom of age-related hearing loss?" Each participant received 100% if all five questions were answered correctly, 80% if four questions were answered correctly, 60% if three questions were answered correctly, 40% if two questions were answered correctly and 20% if one question was answered correctly. If a participant answered all the questions incorrectly, a score of 0% would result.

Self-efficacy was measured through two multiple-choice questions. The first question was: *How well do you agree with this statement: "I feel confident going for a hearing test after reading this article".* The answer options were: *(A) agree, (B) neutral, (C) don't agree.* Three points were given if option (A) was chosen, two points were given if option (B) was chosen and one point was given if option (C) was chosen. Thus, higher scores indicated higher self-efficacy.

The second self-efficacy question required the participant to choose the statement which they agreed with the most. Statement A was: *"I understand the information very well. It will help me to have a good discussion with my hearing health professional".* Statement B was *"I understand about half of the information. It will help me to have a very short discussion with my hearing health professional"*. Statement C was: *"I understand less than half of the information. It won't help me have a discussion with my hearing health professional".* Participants received three points if Statement A was chosen, two points if Statement B was chosen and one point if Statement C was chosen. Thus, higher scores indicated greater self-efficacy. Each participant's scores from the two self-efficacy questions were summed to give a total score out of 6, with higher scores representing higher self-efficacy.

Demographical information such as age, gender, ethnicity, age upon leaving high school, highest qualification achieved and occupation were also obtained from each participant. Participants typed in their occupation and the researcher then grouped the occupations into categories (for example Arts and Media) adapted from Careers New Zealand (Careers New Zealand, 2020). Participants indicated their ethnicity by choosing from a list of ethnicity categories adapted from the New Zealand Census ethnicity categories (Statistics New Zealand, 2018).

2.8 Statistical Analyses

The statistical analyses in this study were performed using the Statistical Package for the Social Sciences, Version 26 (SPSS 26). The various analyses performed will be described in detail in Chapter 3.

CHAPTER 3: RESULTS

3.1 Overview

This chapter will compare the readability, suitability, comprehension, self-efficacy, and participant demographics for the unrevised and revised groups. As expected, the revised webpage had substantially better readability and suitability scores than the unrevised webpage. No significant differences were found between the unrevised and revised groups for the demographic variables. However, comprehension and self-efficacy scores differed significantly between the two groups, thus rejecting null hypotheses 1 and 2. Correlations between comprehension and self-efficacy, self-efficacy and age, and comprehension and age were not statistically significant. Thus, null hypotheses 3, 4 and 5 were supported.

3.2 Readability

The RGLs of the unrevised version were above the recommended level of fifth to sixth grade for online health information (Doak et al., 1996; Weiss, 2003). However, the RGL according to the F-K and SMOG fell within recommended limits after revision, as did the mean RGL. The FRE value was not included when calculating the mean RGL as it gives a reading ease score out of 100 and not a reading grade level. The unrevised version's FRE value was 43.9, which is the equivalent of 13th to 16th grade, or at the level of college education (Flesch, 1949). The revised version's FRE value was 82.6 which is equivalent to sixth grade RGL (Flesch, 1949). The RGLs of the unrevised and revised webpages are given in Table 4.

Table 4. *Reading Grade Levels for the Unrevised and Revised Webpages*

Version	F-K	FOG	SMOG	Mean RGL
Unrevised	11.4	14.5	10.6	**12.2**
Revised	4.7	7	5	**5.6**

Note. F-K = Flesch Kincaid, FOG = Gunning Fog Index, SMOG = Simple Measure of Gobbledygook.

A comparison of the readability features between the unrevised and revised webpages are shown in Table 5.

Table 5. *Readability Features of the Unrevised and Revised Webpages*

Readability feature	Unrevised article	Revised article
Word characteristics:		
Average number of syllables per word.	1.72	1.33
Percentage of complex words (words of 3+ syllables).	19.58%	5.58%
Sentence characteristics:		
Average number of words per sentence.	17.14	11.85
Percentage of long sentences (exceeding 22 words in length).	25.4%	0.81%
Percentage of passive sentences.	20%	9.4%

3.3 Suitability

The unrevised and revised webpages were rated according to the SAM criteria by three raters, one of whom was the researcher. The scores for the unrevised webpage ranged from 35.7% to 42.5%. The scores for the revised webpage ranged from 88.1% to 97.5%. An intraclass correlation coefficient (ICC) was calculated using the scores from each of the three raters, to determine the degree of inter-rater reliability. The ICC for single measures using a 2 way mixed model was .988, 95% CI [.849, 1.0]. This indicated excellent agreement beyond chance.

The overall SAM score for the unrevised and revised webpage are shown in Table 6, along with the median scores for each SAM factor. According to the SAM scoring, 0 – 39% indicates material which is ‘not suitable’, 40-69% indicates ‘adequate’ suitability and 70 - 100% indicates ‘superior’ suitability. The unrevised webpage was therefore rated as ‘not suitable’ and the revised webpage was rated as ‘superior’.

Table 6. *Assessment of SAM Factors in the Unrevised and Revised Webpages*

Factor to be rated	Median score for Unrevised Webpage	Median score for Revised Webpage
Content		
Purpose	2	2
Content	0	2
Scope	1	1
Summary/review	0	2
Literacy demand		
RGL	0	2
Writing style, active voice	1	2
Vocabulary	0	2
Context first	1	2
Learning aids (“road signs”)	2	2
Graphics		
Cover graphic	0	2
Type of graphics	0	1
Relevance	1	2
Explanations for tables etc.	0	2
Captions	0	2
Layout and Typography		
Layout factors	1	2
Typography	2	2
Subheadings	2	2
Learning Stimulation, Motivation		
Use of interaction	0	2
Showing desired behaviour	1	2
Motivation – self-efficacy	1	2
Cultural Appropriateness		
Cultural image and examples	1	2
Total SAM score	16	40
Total possible score	42	42
Percent score	**38%**	**95%**

Note: One of the Cultural Appropriateness factors was removed as it was not applicable. The total possible score was adjusted for this non-applicable factor. Median scores were derived from the scores given by each of the three raters.

3.4 Sample Characteristics

A total of 50 people participated in the survey. However, 11 of the participants did not complete their surveys and one participant completed it but did not meet the eligibility

criteria. Consequently, these responses were discarded, and 38 eligible participants remained. Of these participants, 19 participants were randomly allocated to the unrevised group and the remaining 19 were randomly allocated to the revised group. Due to the random assignment of participants to each group, it was predicted that there would be no significant differences in participants' demographic variables (age, gender, ethnicity, qualification, and occupation) between the unrevised and revised groups. This assumption was investigated by employing statistical analyses as described below.

3.4.1 Age of Participants

As age is a continuous variable, an independent samples *t*-test was used to assess for any significant differences between the unrevised and revised groups. The participants ranged in age from 50 to 64 years. Prior to examining the results of the *t*-test, the researcher noted that the Levene's test showed no significant difference in the variance in age between the unrevised and revised groups ($F = 1.366$, $p = .250$). The independent samples *t*-test also showed no significant differences in age between the unrevised and revised groups. The results of the independent samples *t*-test for age are shown in Table 7.

Table 7. *Age of Participants*

Variable	Unrevised	Revised	*t*	*df*	*p*
Age	*M*=56.89 *SD*=4.46	*M*=55.84 *SD*=5.16	.673	36	.505

Note: M = mean, *SD* = standard deviation.

3.4.2 Gender, Ethnicity, Qualification and Occupation of Participants

Chi-square analyses revealed that there were no significant differences between the unrevised and revised groups for gender, ethnicity, qualification, and occupation. However, the chi-square assumption that no categories would have an expected frequency of less than five, was violated when assessing three of the variables (ethnicity, qualification, and

occupation). This was due to the large number of categories present in the data, resulting in each category having fewer than 5 values. The chi-square analyses are shown in Table 8.

Table 8. *Chi Square Analyses of Gender, Ethnicity, Qualification and Occupation*

Variable	Unrevised	Frq	Revised	Frq	X^2	*df*	*p*
Gender	Male	8	Male	5	1.05	1	.50
	Female	11	Female	14			
Ethnicity	NZ European	12	NZ European	12	6.80	5	.22
	Other European	4	Other European	1			
	African American	0	African American	1			
	Asian	0	Asian	3			
	Māori	1	Māori	0			
	Other	2	Other	2			
Qualification	School Certificate	2	School Certificate	2	5.07	5	.45
	University Entrance	1	University Entrance	3			
	UG Cert/Diploma	7	UG Cert/Diploma	3			
	Bachelor's Degree	7	Bachelor's Degree	5			
	PG Diploma	1	PG Diploma	2			
	Master's Degree	1	Master's Degree	4			
Occupation	Admin and Business	4	Admin and Business	2	8.98	8	.38
	Arts and Media	0	Arts and Media	3			
	Customer Service	1	Customer Service	1			
	Education	3	Education	2			
	Finance	1	Finance	4			
	Health/Com Services	5	Health/Com Services	4			
	IT	2	IT	0			
	Retired/Unemployed	2	Retired/Unemployed	3			
	Security	1	Security	0			

Note: Frq = Frequency count, UG = Undergraduate, PG = Postgraduate, IT = Information Technology, Com Services = Community Services

3.5 Comprehension

Null hypothesis 1 stated that there would be no difference in comprehension scores for the unrevised and revised groups. Prior to investigating this, descriptive statistics were run and indicated that no skewness or kurtosis were present in the comprehension scores of both groups. Similarly, a boxplot showed that there were no outliers in both the unrevised and revised groups. However, the Levene's Test for comprehension showed significant differences in the variance in scores between the unrevised and revised groups (p = .001).

This showed that homogeneity of variances was lacking and thus, one of the assumptions of parametric testing had not been met. Therefore, it was necessary to use non-parametric testing. The Independent-Samples Mann-Whitney *U* Test indicated that comprehension was significantly greater for the revised group than for the unrevised group ($U = 91.5$, $p = .007$). Thus, null hypothesis 1 was rejected. The median and range of the comprehension scores can be viewed in Table 9.

Table 9. *Comprehension Scores for Each Group*

Variable	Unrevised	Revised
Comprehension score	*Mdn* = 40 Minimum score: 20% Maximum score: 100%	*Mdn* = 80 Minimum score: 60% Maximum score: 100%

Note: Mdn = Median

3.6 Self-Efficacy

Null hypothesis 2 stated that there would be no difference in self-efficacy scores for the unrevised and revised groups. Descriptive statistics indicated no skewness or kurtosis in the unrevised group, and no outliers were shown in the boxplot. However, the scores for the revised group were skewed although no kurtosis was present. Significant outliers were also revealed in the boxplot for the revised group. Due to the skewness and significant outliers, the assumptions of parametric testing were violated and it was necessary to use non-parametric analysis. The Independent-Samples Mann-Whitney *U* Test indicated that self-efficacy was significantly greater for the revised group than for the unrevised group ($U = 65.5$, $p < 001$). Thus, null hypothesis 2 was rejected. The median and the range of the self-efficacy scores are shown in Table 10.

Table 10. *Self-Efficacy Scores for Each Group*

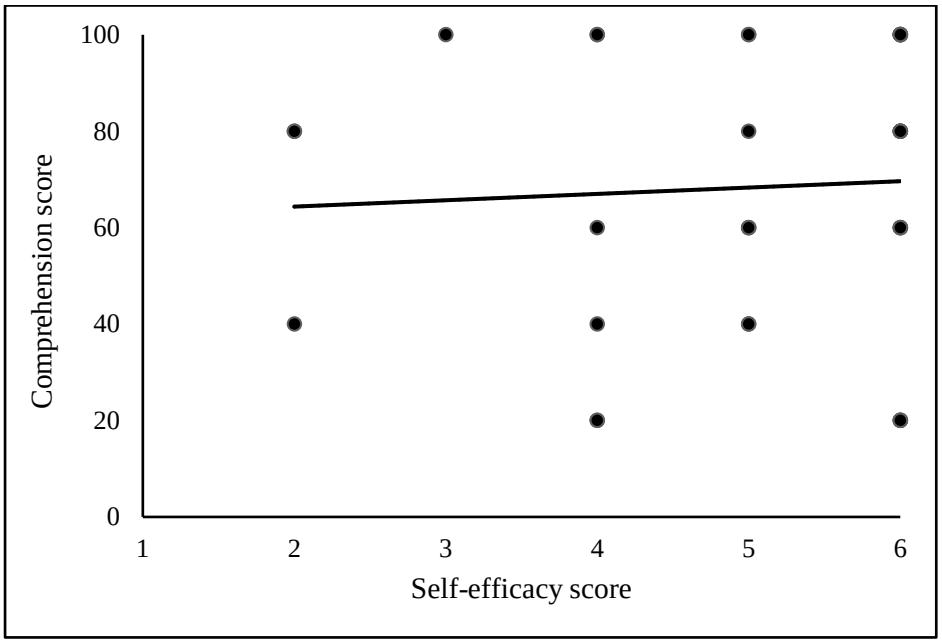
Variable	Unrevised	Revised
Self-efficacy score	*Mdn* = 4 Minimum score: 2 Maximum score: 6	*Mdn* = 6 Minimum score:5 Maximum score:6

Note: Mdn = Median. The maximum possible score for self-efficacy was 6.

3.7 Correlation Between Comprehension and Self-Efficacy

The third null hypothesis proposed that there would be no significant correlation between comprehension and self-efficacy. To determine whether there was a significant correlation between comprehension and self-efficacy, a Spearman's correlation analysis was performed. This revealed a positive correlation between comprehension and self-efficacy, however this was not statistically significant (r_s = .095, p = .570). Thus, null hypothesis 3 was supported. Figure 1 shows the correlation between comprehension and self-efficacy.

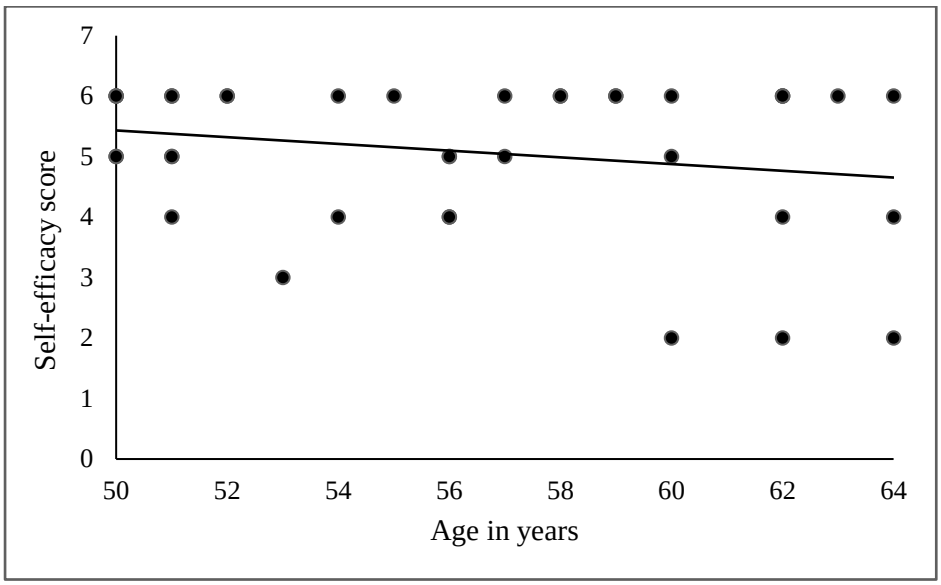
Figure 1. *Correlation Between Comprehension and Self-Efficacy Scores*



3.8 Correlation Between Self-Efficacy and Age

The fourth null hypothesis stated that self-efficacy will not be significantly correlated with age. Spearman's correlation revealed a negative correlation between self-efficacy and age, however this was not statistically significant ($r_s = -.105$, $p = .531$). Thus, null hypothesis 4 was supported. Figure 2 shows the correlation between self-efficacy and age.

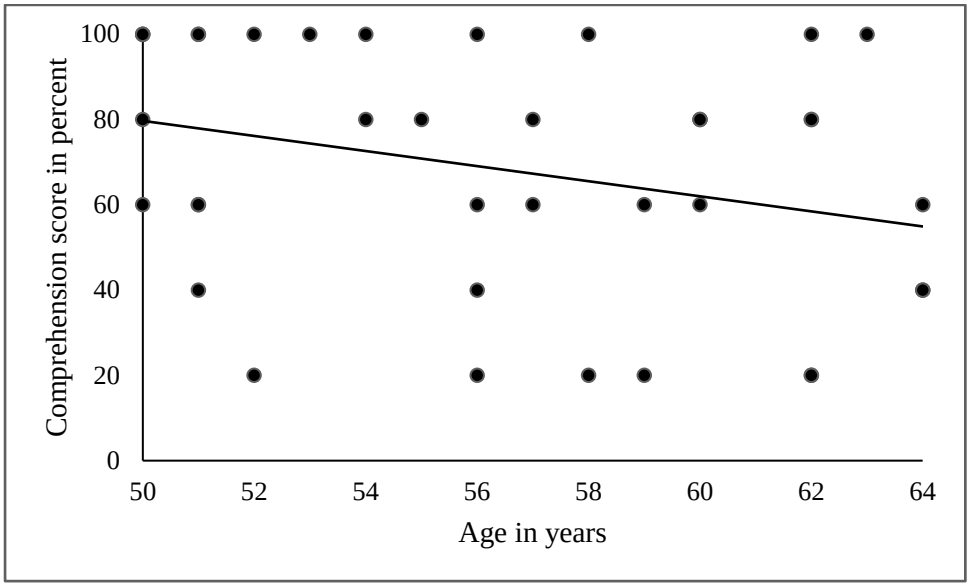
Figure 2. *Correlation Between Self-Efficacy and Age*



3.9 Correlation Between Comprehension and Age

The fifth null hypothesis stated that comprehension will not be significantly correlated with age. Spearman's correlation revealed a negative correlation between comprehension and age, however this was not statistically significant ($r_s = -.309$, $p = .059$). This supported null hypothesis 5. Figure 3 shows the correlation between comprehension and age.

Figure 3. *Correlation between Comprehension and Age*



CHAPTER 4: DISCUSSION

4.1 Introduction

This study found significant differences in comprehension and self-efficacy between groups. No significant correlations were found between comprehension and self-efficacy. Similarly, no significant correlations were found between self-efficacy and age, and between comprehension and age. This chapter will discuss these findings in relation to the literature and present clinical implications, future directions for research and study limitations.

4.2 Readability

The unrevised webpage exceeded the recommended RGL of fifth to sixth grade (Doak et al., 1996; Weiss, 2003) and its FRE reading ease score indicated that the material was ‘difficult’ to read (Flesch, 1948). This finding is consistent with other studies on hearing-related information on the internet (Laplante-Lévesque & Thorén, 2015; Manchaiah et al., 2019; Manchaiah et al., 2020; Simpson et al., 2018; Squires & Ou, 2020). Following revision, the RGL of the webpage was reduced by 6.6 years and its FRE reading score showed that it was ‘easy’ to read (Flesch, 1948).

Substantially reducing the RGL of health information through revision has been illustrated in other studies. Donald and Kelly-Campbell (2016) reduced the RGL of a paediatric audiology report from a mean of 14.8 to 6.95, using the F-K and SMOG formulae. Ming and Kelly-Campbell (2018) reduced the RGL of a tinnitus brochure from a mean of 10.5 to 5.9 using the F-K, FRY, FOG and SMOG formulae. Despite the reduction in RGL, the revised webpage in the current study did not lack necessary information, but contained more details, such as weblinks for further information and the age range of individuals when they first experience symptoms of ARHL. Similarly, the revised report by Donald and Kelly-Campbell (2016) maintained its accuracy after revision, and the revised tinnitus brochure by

Ming and Kelly-Campbell (2018) contained additional details such as contact information and management strategies. This showed that it is possible to revise health information to below 6th grade RGL whilst still including relevant details and maintaining accuracy.

4.3 Suitability

The current study is consistent with previous studies which showed that hearing-related information can be revised from a low suitability rating to a 'superior' level of suitability through adhering to best practice guidelines. The unrevised webpage was rated as 'not suitable' according to the SAM criteria. According to Squires and Ou (2020), 11.8% of internet-based information on ARHL accessible to the public was rated 'not suitable', and the remaining 88.2% was rated 'adequate', using the SAM criteria. However, Caposecco et al. (2014) found that 70% of the hearing aid user guides in their study were 'not suitable' and only 30% was 'adequate'. Considering that older adults are the target audience for information on ARHL, it is essential to ensure that the material is suitable for their needs. Some older adults may have lower health literacy, visual degeneration or cognitive degeneration which can affect the comprehension of written material (Caposecco et al., 2011). Therefore, making the material more suitable will increase the likelihood that the target audience will understand it.

The strengths of the unrevised webpage were its clear statement of purpose, the use of learning aids through headings which introduced the next topic and appropriate typography. These strengths were also reported in other studies which investigated the suitability of online hearing-related information (Elmadani, 2019; Folkerts, 2020; Goddard, 2020; Squires & Ou, 2020). For example, Squires and Ou (2020) found that the majority of material on age-related hearing loss on the internet had an explicit statement of purpose and would therefore enable readers to quickly determine if the information was relevant to their needs. The use of 'advanced organisers' to prepare readers for the next topic was reported as a strength in

information about noise-induced hearing loss (Elmadani, 2019) and information on ARHL on the internet (Squires & Ou, 2020). Typography was a strength which was present in the current study's unrevised webpage and other studies. Typography was found to be 'superior' in online patient education materials on noise-induced hearing loss, (Elmadani, 2019), single-sided deafness (Folkerts, 2020), and information on implantable hearing devices (Goddard, 2020).

The current study's unrevised webpage displayed weaknesses in its content which was based on facts rather than on promoting desirable behaviour, its lack of summary, high RGL, use of difficult vocabulary and lack of interaction. Similarly, other studies also found the same shortcomings in other online hearing-related material. Summaries were lacking in material on noise-induced hearing loss (Elmadani, 2019), single-sided deafness (Folkerts, 2020) and ARHL(Squires & Ou, 2020). Doak et al. (1996) recommended that summaries should restate the main points in different words as this would help to reinforce understanding. In the current study, two summaries were incorporated into the revised webpage. Similar to the current study's unrevised webpage, interaction and suitable graphics were also found to be lacking in online hearing-related material (Elmadani, 2019; Folkerts, 2020; Goddard, 2020; Squires & Ou, 2020). However, in accordance with recommendations by Doak et al. (1996) to achieve reader interaction, the researcher included question-answer headings and quizzes into the revised webpage. Additionally, the researcher also replaced the unrevised webpage's irrelevant cover graphic of a single leaf and replaced it with a photo of a group of people conversing in order to better convey the message of the material.

Cultural appropriateness is an essential element to consider when revising material, because deficiencies in this area could lead to the material being rejected by the target audience (Doak et al., 1996). Primary cultural factors can include race, ethnicity, language, nationality, and religion, whilst secondary cultural factors might include age, gender, and

education (Clayton, 2010). The researcher increased the cultural appropriateness of the webpage on ARHL by having a cover image depicting males and females in the target age bracket (50 to 65 years old) conversing together. This was done because portraying people who look similar to the target audience can increase the material's cultural appropriateness and relevance (Friedman & Hoffman-Goetz, 2006). This was supported by Caposecco et al. (2011) in the development of instructions for a self-fitted hearing aid. Caposecco et al. (2011) noted that their instructions could be made more appealing by having a photo of an older adult on the cover.

Previous studies have revised audiology related material to a 'superior' level, using best practice guidelines (Caposecco et al., 2016; McMullan et al., 2018; Ming & Kelly-Campbell, 2018). For example, McMullan et al. (2018) used larger font, shorter sentences, subdivisions, summaries, bolded keywords, and line drawings in the revision of a hearing aid guide. These best practice guidelines were also used in the current study to revise the webpage. For example, subdivisions were used to further divide up the section 'what happens in a hearing test' to make it easier to follow. Further changes made by the researcher included adding captions to the graphics and achieving a clear layout by ensuring adequate spacing between sections. Similar modifications were also made by Caposecco et al. (2016) in the revision of a hearing aid user guide which achieved 'superior' suitability.

4.4 Effect of the Revision on Comprehension

Comprehension was significantly higher in the revised group than in the unrevised group. Similarly, previous studies in other health disciplines have demonstrated that comprehension increased significantly as a result of revision. These include revisions to material on polio vaccination (Davis et al., 1996), bronchoscopy procedure (Estey et al., 1991), smoking cessation (Meade et al., 1989) and asthma (Horner et al., 2000). These

studies reported that the RGLs were reduced during the revision to fifth and sixth grades, as recommended by Doak et al. (1996), Estey and Keehn (1991) and Weiss (2003).

Comprehension can be substantially improved when differences in the level of thinking between health professionals and consumers are reduced (Doak et al., 1996). Donald and Kelly-Campbell (2016) illustrated this through requesting feedback from the target audience when revising a paediatric audiology report. The feedback from their participants showed that readers had a poor understanding of the original report intended for health professionals. Instead, the participants desired the use of simple language, the inclusion of graphics and a logical structure which highlighted keypoints (Donald & Kelly-Campbell, 2016). These suggestions pertaining to simple language, graphics and structure made by Donald and Kelly-Campbell's participants were incorporated into the revised webpage of the current study.

In addition to achieving a RGL within recommended limits, writing in a manner which has an easy conversational flow is equally important when revising material. Participants in the study by Donald and Kelly-Campbell (2016) expressed their desire for the revised report to be written in "plain English" and "everyday language". The Plain Language Guidelines of the US Plain Language Action Information Network (2011) have provided suggestions of how to write in a manner which readers can easily understand. Some examples of these guidelines are to use personal pronouns, present tense, active voice, and common words (US Plain Language Action Information Network, 2011). Because writing in a conversational style can increase comprehension due to the use of familiar words and syntax, the researcher utilised the Plain Language guidelines in the writing of the revision.

Readers' comprehension can however be decreased by external factors such as distractions or anxiety (Estey et al., 1991). This was shown in the current study where some

of the participants from the revised group did not attain 100% in their comprehension scores although the RGL was within recommended limits and within their expected reading level. This highlighted the necessity to provide information which is very easy to understand so that key points can be comprehended despite external distractions. Improving suitability factors such as layout can therefore help to make it more likely that readers are able to locate key points, even when faced with distractions. Enhancing the suitability factors in the current study enabled the revised webpage to achieve 'superior' suitability and significantly greater comprehension. This was consistent with findings from a previous study which also showed significantly greater comprehension in the revised group, when the revision attained 'superior' suitability (Ming & Kelly-Campbell, 2018).

In audiology, only two studies to date have investigated the effect of revising material on participants' comprehension scores (Donald & Kelly-Campbell, 2016; Ming & Kelly-Campbell, 2018). Both studies found that comprehension was significantly improved for the revised version. Other audiological studies have assessed participants comprehension indirectly by requiring them to perform hearing aid tasks after reading either an unrevised or revised hearing aid guide (Caposecco et al., 2016; McMullan et al., 2018). As expected, participants who used the revised guides had significantly better scores in their hearing aid management tasks, which indicated better comprehension of the instructions. Together, these findings show that comprehension can be significantly increased when both readability as well as suitability factors are improved.

4.5 Effect of the Revision on Self-Efficacy

A significant difference was found in the self-efficacy scores between the unrevised and revised groups and thus, null hypothesis 2 was rejected. The significant effect of group allocation on self-efficacy scores is consistent with other studies in audiology (Donald & Kelly-Campbell, 2016; McMullan et al., 2018; Ming & Kelly-Campbell, 2018). Studies in

other health disciplines have reported higher levels of self-efficacy as a result of patients feeling empowered after gaining more knowledge (DeWalt et al., 2006; Johansson et al., 2005; Pellino et al., 1998; Wong et al., 2010). For example, patients who attended pre-operative education had higher self-efficacy due to feeling informed (Pellino et al., 1998). Similarly, patients who attended an educational intervention had increased self-efficacy and reduced anxiety (Wong et al., 2010). Thus, these studies support Bandura's theory that individuals' self-efficacy for adopting healthy behaviours can be fostered by providing strategies on how to manage and take control of their health (Bandura, 1997).

In the current study, higher self-efficacy was expected in the revised group for a number of reasons. Firstly, the revised webpage provided strategies on what to do if an individual suspected a hearing loss. For example, the webpage urged individuals to see a hearing health-care professional for a hearing test, informed them that hearing loss can be managed by wearing hearing aids and to discuss hearing aid styles with their hearing health-care professional. Secondly, the revised webpage described the hearing test in detail, using simple language to help the participants understand the procedures of a hearing test. This was important as it might alleviate any anxiety associated with having a hearing test. As negative emotional states such as stress and anxiety are associated with lower self-efficacy, reducing stress and anxiety levels can increase self-efficacy (Bandura, 1997).

Thirdly, the revision allowed the reader to experience multiple successes which is important as success or 'performance accomplishment' is the largest source of self-efficacy (Bandura, 1997). This was done through subdividing the material into shorter sections to give the reader a sense of achievement after completing each section and including simple quiz questions to give readers evidence of their success in understanding. McMullan et al. (2018) also incorporated strategies to increase reader self-efficacy in the revision of a hearing aid guide by organising the instructions in order of difficulty – from simple to complex. This

would enable participants to experience success each time they accomplished an easy task, and thus develop self-efficacy for further tasks.

Similarly, significantly higher self-efficacy was reported in participants who read the revised version (Donald & Kelly-Campbell, 2016; Ming & Kelly-Campbell, 2018). Both studies included website addresses into the revisions in order to guide participants to further useful sources of information (Donald & Kelly-Campbell, 2016; Ming & Kelly-Campbell, 2018). Likewise, the current study incorporated weblinks for further information and for locating the reader's nearest hearing clinic. This made it easier for participants to search for further information, and thus increased their self-efficacy for obtaining further help and information.

4.6 Relationships between Comprehension, Self-Efficacy and Age

4.6.1 Relationship Between Comprehension and Self-Efficacy

In this study, comprehension scores were not significantly associated with self-efficacy. This finding supported null hypothesis 3. This section will discuss findings from previous studies which have correlated health literacy or knowledge, with self-efficacy because to the researcher's knowledge, no other study has correlated comprehension scores with resulting self-efficacy for self-care. Various studies have shown a significant, positive association between knowledge and self-efficacy (Kalichman et al., 2005; Tiraki & Yılmaz, 2018; Xu et al., 2018) and between health literacy and self-efficacy (Bohanny et al., 2013; Reisi et al., 2016; Von Wagner et al., 2009). This suggests that knowledge and health literacy empower individuals to feel self-efficacious for the task.

However, several other studies have reported that health literacy was not significantly associated with self-efficacy when participants had only 'basic' or 'functional' health literacy (Inoue et al., 2013; Ishikawa et al., 2008; McCleary-Jones, 2011). A positive association with

self-efficacy was only found when higher levels of health literacy such as interactive (also called ‘communicative’) and critical health literacy were present (Inoue et al., 2013; Ishikawa et al., 2008). This indicated that individuals require a sufficiently high level of health literacy before self-efficacy substantially increased. Functional health literacy requires elementary reading skills to comprehend health information, interactive health literacy involves obtaining and applying health information from various sources, whilst critical health literacy involves critically analysing health information to make decisions (Nutbeam, 2000).

The lack of association between comprehension and self-efficacy in this study might be because some participants had only functional health literacy skills and not beyond. According to Kutner et al. (2006) 13% of individuals with Bachelor’s degrees have basic or below basic health literacy. This demonstrates that it is possible to be educated and yet have low health literacy levels. Furthermore, the majority of the participants undertook the study’s questionnaire in New Zealand and the average level of health literacy in New Zealand is poor (Ministry of Health, 2010).

Another possible reason for the lack of association between comprehension and self-efficacy is that self-efficacy might be associated with other factors apart from comprehension. As self-efficacy is influenced by performance accomplishment and vicarious experience (Bandura, 1997), participants who had succeeded in having frequent, positive interactions with health professionals would have higher self-efficacy than those who had negative experiences. Participants who are more experienced in managing their existing chronic conditions and discussing with their health providers are also more likely to have higher self-efficacy for self-care (White et al., 2013).

Likewise, participants who have seen family members or friends have positive experiences with their healthcare (vicarious experience) might have higher self-efficacy for

discussing their hearing-related needs with a health professional. As negative emotional states can also affect individuals' self-efficacy, participants who may have been experiencing stress or depression might have less self-efficacy for acting on their hearing, despite having understood the information. Self-efficacy is also associated with the level of social support available to the individual (Bandura, 1997). Therefore, individuals who perceived a greater degree of support from family and friends might have higher self-efficacy than those who perceived a lesser extent of social support (Xu et al., 2018).

4.6.2 Relationship Between Self-Efficacy and Age

There was no significant association between self-efficacy and age in this study. Thus, null hypothesis 4 was supported. Some studies have shown no association between self-efficacy and age (Amtmann et al., 2019; Seeman et al., 1993) whilst others have shown a significant negative association (Cybulski et al., 2017; Desrichard & Köpetz, 2005; Lev et al., 1999; Wang et al., 2019). Various studies on self-efficacy in older adults have indicated that age itself was not a significant influential factor on self-efficacy. Instead, self-efficacy was associated with factors such as self-perceived age (Yeom, 2014), personality traits (O'Shea et al., 2017) and amount of social support (Amtmann et al., 2019). Self-perceived age was associated with lower self-efficacy when individuals had a negative outlook on ageing (Tovel et al., 2019; Yeom, 2014), however positive attitudes towards ageing was associated with higher self-efficacy (Julvesano, 2019). . A large study on older adults revealed that personality traits such as conscientiousness, extroversion and openness were associated with higher self-efficacy, however introversion and depressive tendencies were associated with lower self-efficacy (O'Shea et al., 2017).

Amtmann et al. (2019) found that self-efficacy was not significantly associated with age, however greater self-perceived usefulness to friends and family, resilience and social support was associated with higher self-efficacy (Amtmann et al., 2019). Freedom from pain

and fatigue was also associated with greater self-efficacy (Amtmann et al., 2019). Amtmann and colleagues suggested that the lack of significant association between self-efficacy and age in their study might be due to the greater extent of experience the older participants had for managing chronic conditions, as they had spent more years learning how to cope with it (Amtmann et al., 2019). Thus, their experience mitigated any negative effects of age on self-efficacy (Amtmann et al., 2019).

In the current study, no association was found between self-efficacy and age, despite many studies suggesting that a negative association could be expected. Some participants in the study might already be experienced in managing existing health conditions and if so, this would be likely to have raised their self-efficacy for managing hearing loss. Similarly, it might be possible that they had a high level of social support and the aforementioned positive personality traits associated with higher self-efficacy. The majority of the participants in the current study were resident in New Zealand when they responded to the study's questionnaire. New Zealand has a Healthy Ageing Strategy which supports older New Zealanders in managing their health and wellbeing by connecting them to their community and with health professionals (Ministry of Health, 2016). It is likely that participants in this study were aware of their available support and thus their self-efficacy did not decline with age. Combined, these factors might have mitigated any negative effects of age on self-efficacy, resulting in no significant association being found.

4.6.3 Relationship Between Comprehension and Age

A negative association between comprehension and age was found, however this was not statistically significant. Thus, null hypothesis 5 was supported. The lack of association might have been due to the narrow age range of the participants. A study by De Beni et al. (2007) found no significant differences in reading comprehension between a group with a mean age of 70 years (range 65 to 74 years) and another group with a mean age of 78 years

(range 75 to 85 years). The age range of the participants in the current study was narrower than the aforementioned age range in De Beni's study. Thus, a significant association between age and comprehension would be unlikely considering the limited age range in the current study.

Another reason for the lack of association might be because all the participants in the current study were younger than 85 years old, which is the age at which cognition might begin to deteriorate more markedly (Baltes & Smith, 2003). Deteriorating cognition affects individuals' working memory which is required to process text (Waters & Caplan, 2001) as well as the ability to disregard irrelevant information (De Beni et al., 1998). However, these age-related declines in reading comprehension can be mitigated when individuals keep themselves mentally active (Margolin, 2018). As most of the participants in the current study were still working and not yet retired, it is likely that they remained mentally stimulated. Additionally, it can be expected that most of the participants had good reading comprehension skills because their agreement to participate in the current study's online questionnaire indicated a sufficient level of comfort with comprehending written information.

Furthermore, the material in this study might not have been sufficiently difficult to elicit a pronounced difference in comprehension due to age. A study showed that young and elderly participants performed fairly similarly in a comprehension task on narrative texts (Tun, 1989). Narrative text is easier to understand as it is less complex in content and structure than expository texts (Budd et al., 1995). Therefore, if the material in the current study was not sufficiently complex in content and structure, comprehension can be expected to remain unaffected by age.

4.7 Limitations and Future Research

The study had a number of limitations. Firstly, 52% of the participants had a Bachelor's degree or higher. In contrast, only 24.84% of the New Zealand population have a Bachelor's degree or higher, according to the 2018 Census (Statistics New Zealand, 2020). The number of older adults with Bachelor's degrees might be even fewer, as for instance, only 4.6% of women and 6% of men between 20 to 24 years old had a Bachelor's degree or higher in 1985 (Statistics New Zealand, 1985). Therefore, the participants in the current study would have been more highly educated and have better reading comprehension than the overall population.

A second limitation in the current study was the lack of Māori people among the study participants. In the study, Māori comprised 2.6% of the participants, however according to the 2018 New Zealand Census, 16.5% of the population are Māori (Statistics New Zealand, 2020). The lack of Māori participants is noteworthy, especially because Māori have been shown to have poorer health literacy than the non- Māori population, regardless of age and level of education (Ministry of Health, 2010). Māoris aged between 50- 65 years were also found to have among the lowest health literacy compared to the rest of the New Zealand population (Ministry of Health, 2010). This reiterated the fact that the participants in the study were predominantly individuals with higher levels of literacy.

Thirdly, the questionnaire was delivered online and therefore people who did not own or have access to a device or the internet were unable to participate in the study. Those who use the internet as a source of information are those with higher levels of education (Carlson et al., 2006; Cruz-Jesus et al., 2016; Elena-Bucea et al., 2020). Additionally, individuals who have greater access to information technology tend to have higher socioeconomic status and thus greater learning opportunities (Mossberger et al., 2006). Nevertheless, the researcher endeavoured to recruit a broad range of participants through using a snowball recruitment

process and advertising the study in public places such as community noticeboards in libraries and supermarkets.

Fourthly, the questionnaire relied on the honesty of participant responses. Some participants might have completed the questionnaire with the help of a friend or family member and this would have affected the validity of their answers. The researcher requested that only those who had not had a hearing test could undertake the study. This also relied on the participants' honesty. If they had already had a hearing test, their responses would have been affected.

Fifthly, there were only two self-efficacy questions and therefore only a limited indication of self-efficacy could be obtained. The self-efficacy questions were not taken from a validated self-efficacy questionnaire therefore limited comparisons can be made between self-efficacy responses in the current study and that of other studies. Each self-efficacy question was marked on a three point scale and this might have limited the extent to which the participants could depict their self-efficacy. A wider scale such as a ten point scale would allow participants to depict their self-efficacy level in more detail and thus give a truer representation of their self-efficacy. As the self-efficacy responses were self-reported, they could have been affected by individuals' underestimation or overestimation of their perceived self-efficacy.

Sixthly, the two other researchers who rated the suitability using the SAM tool were supportive colleagues of the researcher and might have felt obliged to award a high SAM score for the revised version. Thus, in future, impartiality might be increased if the SAM raters were blinded to the author of the revision.

Future studies which involve revision of material could include participant feedback which could reveal potential misunderstandings and suggest ways of making the material

more understandable and appealing. Additionally, participants of low literacy and from ethnic minorities could be included in order to gain a more accurate representation of the population. In order to include participants who do not have easy access to a device or the internet, researchers might consider the option of also administering it in print in future studies. Consumers who search for health information on the internet prefer webpages where key points can be quickly located, therefore future studies could investigate the amount of time required for key information to be found and understood on webpages. Additionally, self-efficacy could be better assessed by having more questions and providing a wider scale for participants' responses.

The current study limited the age bracket of the participants in order to represent the age at which ARHL first becomes noticeable. However, this limited age range did not allow noticeable age-related differences in comprehension or self-efficacy to be found. Future studies aiming to investigate age-related effects on comprehension and self-efficacy should therefore aim to recruit participants from a wider age bracket.

4.8 Clinical Implications

The current study showed that most information on hearing-health on the internet have RGLs which are too high and suitability which has room for improvement. Once readability and suitability are improved, readers have better comprehension and self-efficacy. There is therefore an urgent need to improve patient education materials on the internet so that consumers can understand it and feel self-efficacious to take action to improve their health.

When developing patient education materials writers should aim to overcome any barriers in understanding due to differences in thinking between health professionals and consumers. This can be achieved by improving the material's RGL and suitability, as well as

ensuring that the writing style has a familiar, conversational flow. As learning involves building on ones' existing knowledge, comprehension can be improved through using familiar terms and concepts in health materials (Fisher et al., 2012; Wolfe & Goldman, 2005). Combined, these strategies will increase the likelihood that the material will be comprehended easily. However, it is important to note that comprehension can be decreased by distractions or by readers' heightened emotional states. This further highlights the importance of providing material which is easy to understand.

Developing health education materials for older adults has unique challenges because older adults use more effort and attentional resources than younger adults when reading (Fitzhugh et al., 2019). Consequently, they might struggle to understand if the writing is too complex. Difficulties in comprehension can be eased when the material is structured in a logical manner. Additionally, removing unnecessary information is advisable because the ability to disregard irrelevant information in the text declines with age (De Beni et al., 1998). In a target audience of older adults, age-related conditions for example macular degeneration, can affect the accuracy of reading comprehension (Varadaraj et al., 2018). Therefore, aspects such as layout and typography are especially important to ensure that the material is visually easy to decipher.

As self-efficacy is also influenced by factors such as self-perceptions of ageing and extent of social support, healthcare providers could educate consumers on healthy ageing to promote positive attitudes and counteract incorrect beliefs about ageing (O'Shea et al., 2017; Yeom, 2014). Older adults who participate in more social activities develop a greater number of social connections, and this was associated with higher self-efficacy (Amtmann et al., 2019). Therefore, communities could promote and organise social activities for older adults in order to broaden their social networks and increase self-efficacy. Furthermore, having social connections might help to decrease isolation and depression which is associated with

lower self-efficacy. Because the main source of self-efficacy is performance accomplishment (Bandura, 1997) writers of health information must encourage the reader to persist in their efforts as this leads to improvement and success. Including practical tips such as following a routine can also increase the likelihood of success. Emphasising that health professionals are happy to help and providing contact details for further assistance might reassure the reader, alleviate anxiety, and therefore increase self-efficacy.

When communicating with patients in person, health professionals can make themselves more understandable to their patients by using familiar terms when speaking with them. Health professionals can help patients obtain to information which is understandable by firstly checking the RGL and suitability of webpages before recommending them to patients. This can be done through using readability calculators on the internet and the SAM tool. Providing patients with appropriate information can lead to many benefits, such as higher self-efficacy for self-care and increased confidence to participate in shared decision making.

4.9 Conclusion

There is a need to provide internet based information on hearing health which is easily readable and therefore actionable. Consistent with the findings from previous studies, this study found that comprehension and self-efficacy were significantly higher in participants who read the revised material compared with those who read the unrevised material. It is essential to consider the target audience when developing health materials. Some older adults might require materials with RGLs below fifth grade and extremely clear layouts due to their cognitive or visual difficulties.

In this study, the lack of significant association between comprehension and self-efficacy, and between self-efficacy and age suggests that other factors can also be associated with self-efficacy. Other studies have proposed that these factors include self-perceived age

and amount of social support. In addition to providing comprehensible health materials, efforts to increase self-efficacy in older adults should therefore include educating individuals on healthy ageing, reassuring individuals that health professionals are available to help and promoting participation in social activities in order to expand individuals' social networks. In audiology, higher self-efficacy is associated with positive health behaviours such as making the decision to use amplification. This leads to improved communication, quality of life and earning potential. Providing comprehensible information as well as employing additional strategies to further develop self-efficacy in older adults will therefore lead to positive outcomes.

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APPENDICES

APPENDIX A: Ethics Approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Rebecca Robinson
Telephone: +64 03 369 4588, Extn 94588
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2019/07/LR Amendment 2

14 February 2020

Rebecca Kelly
Psychology, Speech and Hearing
UNIVERSITY OF CANTERBURY

Dear Rebecca

Thank you for your request for an amendment to your research proposal "Quality of Hearing-Related Internet Information" as outlined in your email dated 10th February 2020.

I am pleased to advise that this request has been considered and approved by the Human Ethics Committee.

Yours sincerely

Dr Dean Sutherland
Chair, Human Ethics Committee

APPENDIX B: Unrevised Webpage

Everything you need to know about presbycusis

Presbycusis definition can be complicated but simply put it is a slowly progressing sensorineural hearing loss. It always affects both ears to the same degree, and usually starts at the age of 50. One characteristic of presbycusis is that sounds within the high-frequency range are significantly impacted (more so at the start of the illness) more than deeper sounds.

Consequently, speech intelligibility is hampered more severely than the capacity to hear sounds – especially when impaired hearing is subjected to an intensely noisy environment. Doctors use the term “cocktail party effect” to refer to the ability to focus on a single speaker or conversation in a noisy setting. In other words, if a person can hear what someone is saying in a crowded, noisy party, even if they are half way across the room, it is more than likely that he or she is experiencing the cocktail party effect.

Overview

Causes of presbycusis

Presbycusis is a medical health condition that develops for a number of reasons, some of which include a wide range of ear disorders. Damaging external influences also play a significant role. Typically, these are patients who have been frequently subjected to blaring noise throughout their lives. Another possible cause is certain medications, commonly referred to as ototoxic medication, that can damage the ear in the long run. Presbycusis is common amongst adults over the age of 65.

There is also a connection between presbycusis and risk factors such as smoking, high blood pressure, and diabetes mellitus. Age-associated processes, like progressive impairment of the hair cells, also play an important role. The hair cell receptors are located in the inner ear's organ of Corti and are responsible for the actual hearing process. If these are damaged due to continuous noise pollution, for example, external sounds can no longer be properly perceived, resulting in impaired hearing. A genetic predisposition may also be a contributing factor.

Diagnosis

To correctly diagnose presbycusis or age-associated hearing loss, and initiate the appropriate treatment with a hearing aid, it is imperative to exclude other causes or illnesses. Among other things, this includes the examination of the ear using a specialist microscope (ear microscopy). In patients suffering from presbycusis, the ENT specialist will usually find a normally structured eardrum (i.e. no tear or hole in the eardrum). A pure-tone and speech audiogram are also performed to ultimately confirm the diagnosis. If all other causes can be excluded, the ENT specialist will usually recommend the provision of a hearing aid. Modern hearing aids can treat presbycusis efficiently and restore near-perfect comprehension of speech, tones and sounds.

Speech audiometry

During the speech audiometry exam, a certain number of words are presented to the patient via headphones and he/she will have to repeat them. Once the test is complete, the information collected from the exam will help doctor determine if there is a deficit in speech comprehension.

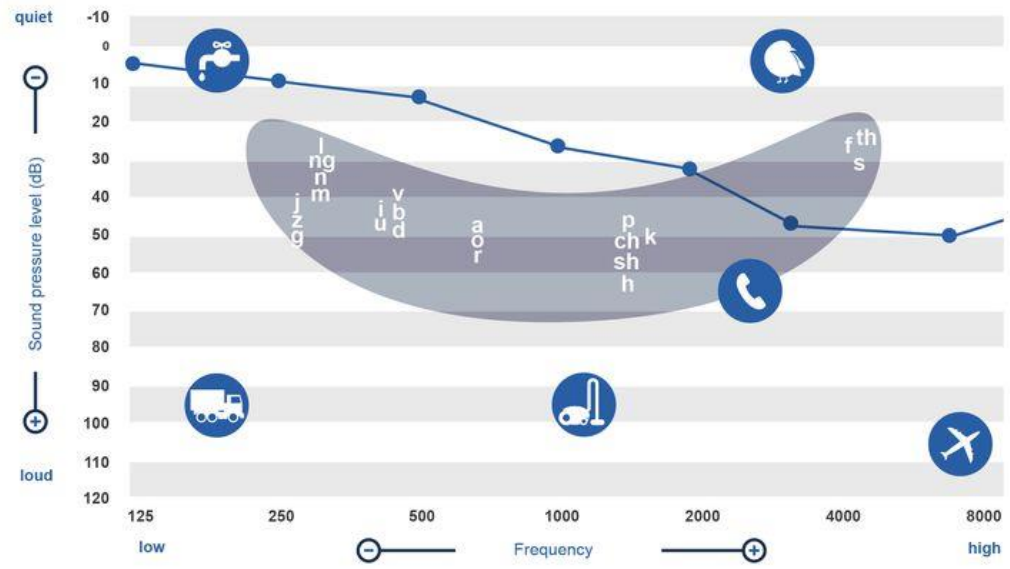
If speech audiometry is performed on a patient with presbycusis, the examination will reveal impaired speech comprehension.

Pure-tone audiometry

During pure-tone audiometry, patients are subjected to high and low tones at different volumes. The patient is asked to respond to the sounds until they are unable to hear the faintest tone. The results of this exam will consequently yield an auditory threshold curve.

If this examination were to be performed on a patient with presbycusis, a loss in the perception of high tones would become apparent: in such cases, the auditory threshold curve would be inferior, particularly in the high-frequency range.

This type of hearing loss goes beyond the maximum age-associated hearing loss. If the illness has progressed further, deeper tones could also be affected.



Symptoms of presbycusis

There are many symptoms of the presbycusis that make it easier to identify. But some of the symptoms can be indicative of other health/medical issues.

- Hereditary factor: Presbycusis can be hereditary just like other medical conditions. The important question to ask is; did your parents or other closely related family members have hearing loss? As you could have inherited it.
- Pre-existing medical conditions: other health issues such as high blood pressure or heart disease and can affect the blood supply to the middle ear. Which can be a cause of presbycusis.
- Medication: Ototoxic medication such as aspirins can be a cause of hearing loss. Therefore, it is important to use them in moderation and only when necessary.
- Noise induced hearing loss (NIHL): People who have been exposed to loud noises over a period of time can have presbycusis. This could be loud noises at work, home or for leisure.
- Tinnitus: tinnitus is a very common condition. However, many people with presbycusis complain about buzzing or ringing noises in their ears; tinnitus.

If you fear that you suffer from any of the symptoms or may have presbycusis then it is important to go to a professional audiologist immediately.

Living with Presbycusis

Once you have been diagnosed with presbycusis it is important to get it treated or following it up with the audiologist. For e.g. if you were having other medical concerns or were suffering with your sight, you would look for a treatment, get glasses etc. Similarly, it is important to get a treatment for this. Leaving it untreated or undealt with could lead to other health conditions such as depression, anxiety and could lead to worsening hearing loss. There are treatments out there to help you and ensure that your hearing doesn't get worse and you are able to enjoy your daily life normally. So take the next step.

Treatment of presbycusis

The use of a hearing aid is recommended as treatment for age-associated hearing loss. (Medicinal treatment leading to complete restoration of hearing capacity is currently unavailable.) The long-term consequences of untreated age-associated hearing loss could include increased social isolation or depression. The use of a hearing aid system can, however, help diminish the debilitating symptoms and return some quality of life back to the afflicted person.

APPENDIX C: Revised Webpage

Hearing Loss in Older Adults

- Are you age 50 or over?
- Is it hard to understand conversations when you're in a noisy place?

If you said yes, you may have a type of hearing loss which happens naturally as you get older. This type of hearing loss is called **presbycusis**.

Fact: Around 25% of people between 55 and 64 years old have presbycusis. The older you get, the more chance you have of having presbycusis. 43% of people between 65 and 84 years old have presbycusis. *

* Nash, Scott D., et al. "The prevalence of hearing impairment and associated risk factors: The Beaver Dam Offspring Study." *Archives of Otolaryngology–Head & Neck Surgery* 137.5 (2011): 432-439.

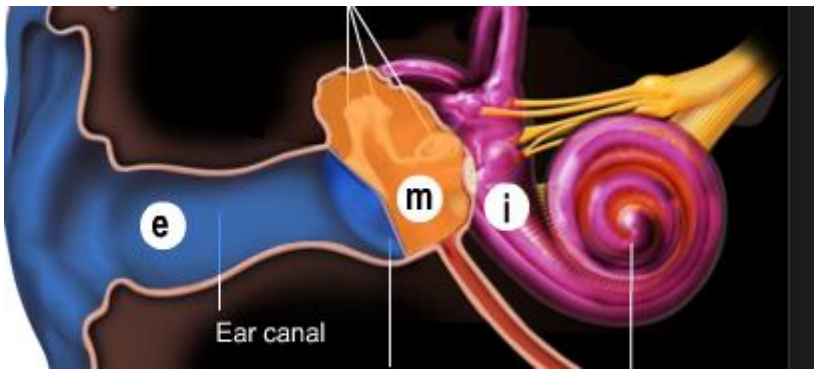
Do you have hearing loss? Some common signs of hearing loss are:

- You often have to ask people to repeat what they are saying.
- You find it very hard to follow a conversation when you are in a noisy place.
- You find it difficult to focus on people's voices when there are other people talking near you.

Contents:

1) Why am I losing my hearing?

Hearing loss can happen to people at any age. Why is it more common in older adults? As you get older, the inner part of your ears don't work as well as they used to. This is a natural part of aging.



This picture shows the three parts of your ear.

The above picture shows that the ear can be divided into three parts. External (e), Middle (m) and Inner part (i). The organ of hearing is called the cochlea. It is found in the inner part of the ear.

The cochlea contains thousands of tiny hairs (called hair cells) that move when there is sound. The moving hair cells send signals to your brain to tell your brain that you have heard a sound. When you grow older, the hair cells do not work as well, so you will start to have a hearing loss.

Are all older adults likely to get hearing loss?

No.

Find out if you are likely to get hearing loss by answering these questions:

- Do you smoke?
- Do you have high blood pressure?
- Do you have heart problems?
- Do you have diabetes?
- Do other people in your family have hearing loss?

If you said yes to any of these questions, you're more likely to get hearing loss as you grow older. Having high blood pressure and heart problems can reduce the blood flow to your inner ear. The lack of blood flow will damage the hair cells in the inner ear and cause hearing loss.

If your parents or relatives have hearing loss, there is a chance that it may be passed on to you. This type of hearing loss is passed down to you from your parents.

Are there any other reasons for my hearing loss?

Hearing loss is also caused by loud noises which can damage the inner ear. Some examples are working in a noisy factory or construction site without wearing any earmuffs. Hobbies such as shooting and listening to very loud music can also damage your hearing.

Some medicines and drugs can damage the hair cells in your ears and give you a hearing loss.

Take the quiz and check your knowledge! Answer Yes or No to the following questions:

1) Will all older adults develop hearing loss?

2) Can listening to loud music damage your hearing?

3) If your parents have hearing loss, will you definitely also have a hearing loss?

4) As you grow older, does your inner ear stop working as well as it used to?

Answers: 1) No. 2) Yes. 3) No. 4) Yes.

2) How do I know if I have a hearing loss?

- You might hear a constant noise in your ears. This is called **tinnitus.** Different people may hear different noises. The noise may sound like a buzzing, ringing or roaring. It may be high and shrill like a bell or a low whooshing noise.

- You often ask people to repeat what they are saying. You find that people with higher voices such as women and children are more difficult to understand.

- You avoid social events because it's too noisy and you can't understand what people are saying.

3) What happens in a hearing test?

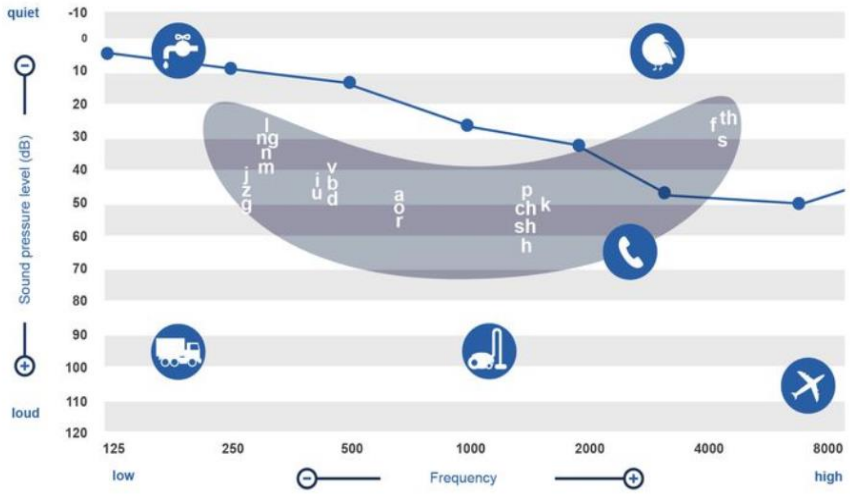
If you want to get your hearing tested, you will need to see a hearing-care professional. Hearing-care professionals such as **audiologists** or **audiometrists** test peoples' hearing and provide them with hearing aids.

At your hearing test, an audiologist or audiometrist will ask you some questions about your general health. He or she will also look inside your ear using a special torch called an **otoscope.** This is to check whether your ears are healthy and clear.

This picture shows a hearing-care professional looking into a client's ear with an otoscope.

Your hearing test Part 1.

Next, you will put on a pair of earphones and hear some beeps. Some of the beeps will be low in pitch and some will be high. Some beeps may be very quiet. You must press the button each time you hear a sound even if it's very quiet. You will then be able to see your results on a chart like this:



This is a chart which shows you your hearing test results.

The chart is called an **audiogram**. The dark blue line on the chart shows how well you can hear. Sounds on the top left are low in pitch and quiet, like water dripping. Sounds on the top right are high in pitch and soft, like a small bird singing. Sounds near the bottom are louder, like a vacuum cleaner.

On this chart, the blue line slopes downwards which means the person does not hear high-pitched sounds very well. This person cannot hear the sounds that are above the blue line, such as birds singing, or the letter sounds ‘f’ ‘th’ or ‘s’ in speech. Because of this, the person may mishear certain words when listening to someone.

Your hearing test Part 2.

Next, you will listen to some words. You will hear the words one at a time. You must say out loud the word you heard. The person testing you will check whether you heard it correctly. As part of the test, some words will be very quiet. Don’t worry if you can’t hear every word clearly.

Summary: Your hearing test will be done by a hearing-care professional. The test has two parts. First, you will listen for beeps and press the button to show that you have heard. Your test results are shown on a chart called an audiogram. Next, you will repeat back words which you have heard. It is alright if you do not hear all the words clearly.

4) How can I improve my hearing?

Your hearing loss can be managed by wearing hearing aids. You can't improve your hearing by taking medicine.

Why should I try hearing aids?

If you have hearing loss, it's a good idea to do something about it. If you wear hearing aids to manage your hearing loss, you will be able to hear better. This means you can keep in touch with your friends and keep your mind stimulated. You will be healthier and happier because of this.

People who don't manage their hearing loss tend to feel lonely because they cannot communicate easily with their friends. This can lead to more serious issues like depression and anxiety.

Some people have only a slight hearing loss but can still manage to get on with their life normally. These people are probably not ready to get hearing aids.

How about you?

Would you like to hear more clearly?
Would you like to join in conversations more easily?

If you said 'yes', you are probably thinking of getting hearing aids, so read on!

What do hearing aids look like?

Your audiologist will talk to you about which style, size and colour suits you the best. Different hearing aids can do different things. Some hearing aids are better at reducing background noise than other hearing aids. Your audiologist will help you decide what's best for you.

This is a 'behind-the-ear' hearing aid.

This is an 'in-the-ear' hearing aid.

Summary: How will my hearing aids help me?

- Makes it easier to understand conversations.
- Lets me feel included because I can follow what is going on.
- Makes it easier and less tiring to go out with my friends because I am not struggling to understand them.
- Makes it possible to hear nature sounds like birds singing, rain falling, trees rustling.
- Helps me live a happier and healthier life.

What now?

Click on this link to find a hearing care professional in your area:

https://betterhearing.org/find-a-hearing-health-care-professional/

Click on this link to read more information about hearing loss:

https://betterhearing.org/

APPENDIX D: Study Information

School of Psychology, Speech and Hearing | Te Kura Mahi ā-Hirikapo

Telephone: 03 369 4519

Email: carolyn.johnson@pg.canterbury.ac.nz

Date: 6 May 2020

HEC Ref: 2019/07/LR

Assessing and Improving the Readability of Online Information on Presbycusis

Information Sheet for participants

My name is Carolyn Johnson. I am a second year, Master of Audiology student at the University of Canterbury. I am conducting a research study that aims to assess the readability and suitability of online information on age-related hearing loss (presbycusis).

Who is being sought?

Adults who are between 50 to 65 years old who have never had a hearing test as an adult, and able to read in the English language.

Am I compensated for my time?

Yes. You can choose to be entered into a draw to win one of two US$ 50 Amazon giftcards.

What do I need to do?

Read online material about age-related hearing loss and then answer questions in an online survey. The questions will ask you about yourself (age, gender, ethnicity, level of education) and will ask you to answer questions about the online material.

What else do I need to know?

Participation is voluntary and you have the right to withdraw or remove yourself from the survey and the research study at any stage without providing a reason or rationale. If you withdraw, all information relating to you will be removed unless data analysis has concluded. After data analysis has concluded, removal of individual data may not be practically achievable.

What happens to the study information or data?

A research thesis is a public document and will be available through the University of Canterbury Library. The results of the research project may be published in a peer-reviewed journal, but everyone taking part in the study may be assured of the confidentiality of all data gathered in this investigation. To ensure anonymity and confidentiality, data will be organized by a unique alpha-numeric code. All research information will be stored in password-protected electronic formats, in keypad locked, research labs at the University of

Canterbury. Only the researcher, supervisor, and co-supervisors will have access. Data will be kept for a period of five years before it is destroyed, per University of Canterbury Human Ethics Committee and research protocols.

What if I want to know about how the research study turned out?

Please email carolyn.johnson@pg.canterbury.ac.nz if you would like to know how the research went.

Who is supervising the research study?

The research project is being carried out as a requirement for the Master of Audiology degree at the University of Canterbury. The primary supervisor is research study is Dr Rebecca Kelly-Campbell - rebecca.kelly@canterbury.ac.nz. In addition, the study is being co-supervised by Megan McAuliffe – megan.mcauliffe@canterbury.ac.nz

Who approved this research study?

This project was reviewed and approved by the University of Canterbury Human Ethics Committee. Participants wishing to lodge a complaint should address any complaints to The Chair, Human Ethics Committee, University of Canterbury, Private Bag 4800, Christchurch human-ethics@canterbury.ac.nz.

I can confirm that I can read English, am between 50 - 65 years of age and have never had a hearing test as an adult.

- Yes
- No

APPENDIX E: Consent Form

Study title: Assessing and Improving the Readability of Online Information on Presbycusis

The information about this research study has been explained to me to my satisfaction.

I know what I need to do to take part in the study.

I know that I can choose whether or not I take part in this research. I know that I may withdraw from the study without penalty by exiting the survey without submitting my answers.

I know that any information or opinions I give will be kept private to the researcher. I know that any published or reported results will not identify me.

I know that all data collected for the study will be kept in locked and secure facilities or in password protected computers and will be destroyed after ten years.

I will be given a copy of this form and the Research Information Sheet.

I know that I can contact the researcher for more information: Carolyn Johnson Carolyn.johnson@pg.canterbury.ac.nz or the primary supervisor, Dr Rebecca Kelly-Campbell: rebecca.kelly@canterbury.ac.nz (03) 369 4519.

If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee, Private Bag 4800, Christchurch, human-ethics@canterbury.ac.nz (03) 364 2987 ext 45588).

I know that if I would like a copy of the study results, I need to contact Carolyn Johnson: Carolyn.johnson@pg.canterbury.ac.nz

- By clicking the continue button, I agree to take part in this research project.

APPENDIX F: Demographic Questions

1) What is your gender?

- Male
- Female

2) What is your age?

3) What is your ethnicity?

- New Zealand European
- Other European
- Maori
- Pacific Islander
- African American
- Asian
- Other

4) At what age did you complete secondary school?

5) What is your highest qualification? For example, School Certificate, Bachelor's Degree, Master's Degree.

6) What is your occupation?

APPENDIX G: Comprehension Multiple-Choice Questions

1) What is an early symptom of age-related hearing loss?

- You cannot hear low bass sounds well.
- You cannot hear high, treble sounds well.
- You cannot hear low and high pitched sounds well.
- You cannot hear medium pitched sounds well

2) What is tinnitus?

- A type of hearing loss caused by noise.
- Noise produced by hearing aids.
- Hearing a noise in your head which is not in the environment.
- Loss of hair cells.

3) You have a higher chance of having age-related hearing loss if

- you are age 40 to 60.
- you are age 65 and above.
- your husband or wife has age-related hearing loss.
- you don't have high blood pressure.

4) Why do people lose their hearing when they get older?

- Because they get more colds and flu when they get older.
- Because the hair cells do not work as well as they used to when people grow older.
- Because of exposure to air pollution.
- Because the outer ear changes shape when people grow older.

5) People who do not take any action about their hearing loss could

- become depressed and withdrawn.
- develop worse eyesight.
- get used to living with hearing loss without any bad effects.
- develop high blood pressure.

APPENDIX H: Self-Efficacy Multiple-Choice Questions

1) How well do you agree with this statement: " I feel comfortable going for a hearing test after reading this article".

- Don't agree
- Neutral
- Agree

2)Which of the following statements do you agree with the most?

- I understand the information very well. It will help me have a good discussion on hearing loss with my hearing health professional.
- I understand about half of the information. It will help me to have a very short discussion on hearing loss with my hearing health professional.
- I understand less than half of the information. It won't help me have a discussion about hearing loss with my hearing health professional.

APPENDIX I: Permission to Use Plain Language Guidelines

Miriam Vincent <miriam.vincent@nara.gov> Sat, Oct 3, 12:49 AM

to me, Information

Ms. Johnson,

The Federal Plain Language Guidelines are freely available for use without restriction as a product of the U.S. Federal government. We ask only that you attribute the work to the Federal Plain Language Action and Information Network (PLAIN) which authors the guidelines and owns www.plainlanguage.gov.

Miriam Vincent
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Office of the Federal Register
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